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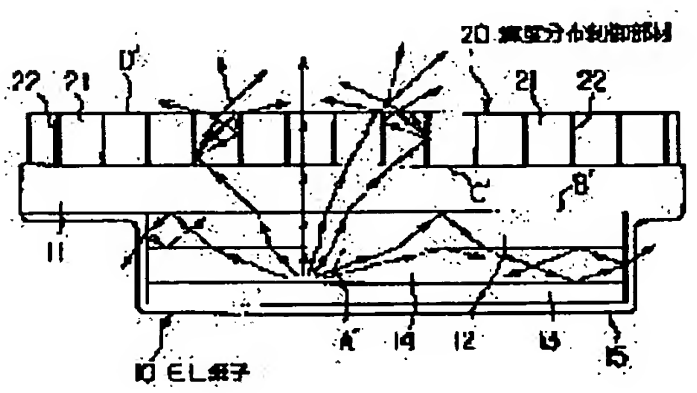
(54) SURFACE LIGHT EMITTING BODY AND LIQIUD CRYSTAL DISPLAY DEVICE USING IT

(57)Abstract:
PROBLEM TO BE SOLVED: To improve luminescence distribution of emission light by increasing luminescence of light to be emitted in a predetermined direction as a surface light emitting body employing an EL element and widening an emission angle range in which the emission light of sufficient luminescence can be obtained.
SOLUTION: An emission face of an EL element 10 is provided with a luminescence distribution control member 20 consisting of a plurality of transparent parts 21 arrayed along a plane direction and a scattering reflection membrane 22 sandwiched between these transparent parts 21, the light incident toward a diagonal direction, of the light emitting the EL element and incident to the transparent parts 21 of the luminescence distribution control member 20 is advanced straight and emitted, and the light emitted toward the diagonal direction is scattered by the scattering reflection membrane 22 and is emitted.



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CLAIMS

[Claim(s)]

[Claim 1] The field emitter characterized by preparing luminance distribution control-section material with the property which the light which the light which carried out incidence toward the predetermined direction among the incident light from the rear face which counters the outgoing radiation side went straight on, carried out [light] outgoing radiation to the front face, and carried out incidence toward other directions is scattered on the outgoing radiation side of an electroluminescent element, and carries out outgoing radiation to said front face.

[Claim 2] Said luminance distribution control-section material is a field emitter according to claim 1 characterized by being on the field where it consists of scatter reflection film inserted between the side faces of two or more area pellucida located in a line along the direction of a field, and these area pellucida, and said scatter reflection film met in said predetermined direction.

[Claim 3] The rear face of said luminance distribution control-section material is a field emitter according to claim 2 characterized by having stuck to the outgoing radiation side of said electroluminescent element.

[Claim 4] The refractive index of the area pellucida of said luminance distribution control-section material is a field emitter according to claim 3 characterized by being almost the same as the refractive index by the side of the outgoing radiation of said electroluminescent element, or being a value near it.

[Claim 5] Said electroluminescent element is a field emitter according to claim 1 characterized by being an organic electroluminescent element.

[Claim 6] The liquid crystal display characterized by consisting of a liquid crystal display component and a field emitter according to claim 1 arranged back [the].

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the liquid crystal display which uses the field emitter and it which used the electroluminescent element (henceforth an EL element).

[0002]

[Description of the Prior Art] The EL element used as a field illuminant is used for the back light of the liquid crystal display component in a liquid crystal display etc. Drawing 7 is the sectional view which omitted hatching of the conventional EL element, and shows what is called an organic EL device here. This organic EL device makes the electroluminescence layer 4 which consists of an organic material intervene

between the transparent outgoing radiation lateral electrode 2 formed in one field of the transparence substrate 1 which consists of glass, and this outgoing radiation lateral electrode 2 and the background electrode 3 which counters, and said outgoing radiation lateral electrode 2 is used as an anode, and let the background electrode 3 be a cathode.

[0003] In addition, said outgoing radiation lateral electrode 2 consists of ITO (indium stannic-acid ghost), or an indium and a zincic acid ghost, and has high permeability to the light wavelength region. Said background electrode 3 is formed from a viewpoint of the electron injection to the electroluminescence layer 4 with Mg system alloys (a Mg-In alloy or Mg-Ag alloy) with a small work function.

[0004] Moreover, although said electroluminescence layer 4 was shown as one layer by a diagram, generally this electroluminescence layer 4 is made into the two-layer structure which carried out the laminating of the electron hole transportation layer to the anode side of an electronic transportability luminous layer, or 3 layer structures which carried out the laminating of the electron hole transportation layer to the anode side on both sides of the luminous layer, and carried out the laminating of the electronic transportation layer to the cathode side.

[0005] If this organic EL device impresses an electrical potential difference (direct current voltage) between that outgoing radiation lateral electrode 2 and background electrode 3, a luminescence drive is carried out and an electrical potential difference is impressed between these two electrodes 2 and 3, an electron is injected into the electroluminescence layer 4 for an electron hole from the background electrode (cathode) 3 from the outgoing radiation lateral electrode (anode) 2, a singlet exciton will occur by the recombination of that electron hole and electron that were poured in, and it will emit light.

[0006] And incidence of the light by this singlet exciton is carried out to the outgoing radiation lateral electrode 2 from the electroluminescence layer 4, and it penetrates the transparence substrate 1 further and it carries out outgoing radiation to that front face. In addition, although there is also light which goes to the rear-face side of the electroluminescence layer 4 among the light which said singlet exciton emits, the light is reflected with the background electrode 3.

[0007] Although the light from this point will be emitted toward various directions as an arrow shows to drawing 7 if the outgoing radiation path of the light from one point of the electroluminescence layer 4 in the above-mentioned EL element is seen Among those, the light which goes in the direction (direction in alignment with the perpendicular to an outgoing

radiation side) perpendicular to an outgoing radiation side (front face of a substrate 1) penetrates the interface of each class of an EL element, and the interface of said outgoing radiation side and open air, without producing refraction and reflection, and they carry out outgoing radiation perpendicularly.

[0008] On the other hand, in order to carry out incidence of the synchrotron orbital radiation which goes in the direction of slant to the interface of said each class aslant, the light is refracted or reflected by said interface. The refractive index of the air this [whose] the refractive indexes of about 2.00 and the transparence substrate (glass) 1 are 1.45-1.80 in the case where the refractive index by the side of the outgoing radiation of the electroluminescence layer 4, for example, the refractive index of the electron hole transportation layer in the electroluminescence layer of 3 layer structures, is [the refractive index of 1.40-1.80, and the outgoing radiation lateral electrode 2] ITO, and is the open air is about 1.0008, and is because the refractive indexes of an adjacent layer differ mutually.

[0009] For this reason, total reflection of the light which the light which carried out incidence of the synchrotron orbital radiation which goes in said direction of slant to the interface A of the electroluminescence layer 4 and the outgoing radiation lateral electrode 2 first, and carried out incidence by the incident angle smaller than a total reflection critical angle to said interface A among that light was refracted by this interface A, carried out incidence to the outgoing radiation lateral electrode 2, and carried out incidence by the larger incident angle than a total reflection critical angle is carried out by said interface A.

[0010] In addition, the light which carried out total reflection by said interface A repeats reflection with the background electrode 3, and reflection by said interface A and the end face of the longitudinal direction of the electroluminescence layer 4, and the light which it refracts and progresses to zigzag, is that process, and carried out incidence of the inside of the electroluminescence layer 4 to said interface A by the incident angle smaller than a total reflection critical angle penetrates this interface A, and carries out incidence of it to the outgoing radiation lateral electrode 2.

[0011] Moreover, total reflection of the light which the light which the light which carried out incidence to the outgoing radiation lateral electrode 2 penetrated this outgoing radiation lateral electrode 2, carried out incidence to the interface B with the transparence substrate 1, and carried out incidence by the incident angle smaller than a total reflection critical angle to said interface B among that light was refracted by this

interface B, carried out incidence to the transparence substrate 1, and carried out incidence by the larger incident angle than a total reflection critical angle is carried out by Interface B.

[0012] A part of light of the light which carried out total reflection by this interface B repeats the total reflection in the interface A with the electroluminescence layer 4, and reflection by said interface B and the end face of the longitudinal direction of the outgoing radiation lateral electrode 2, and the light which refracted and progressed to zigzag and carried out incidence of the inside of the outgoing radiation lateral electrode 2 to said interface B by the incident angle smaller than a total reflection critical angle among that light penetrates this interface B, and carries out incidence of them to the transparence substrate 1.

[0013] Moreover, although other light which carried out total reflection by said interface B penetrates the interface A with said electroluminescence layer 4 and returns to the electroluminescence layer 4 The light refracts and progresses the inside of the electroluminescence layer 4 to zigzag by the above-mentioned interface A like the light which carried out total reflection, and is the process. The light which the light which carried out incidence to said interface A by the incident angle smaller than a total reflection critical angle penetrated this interface A, carried out incidence to the outgoing radiation lateral electrode 2, and carried out incidence to the interface B with the outgoing radiation lateral electrode 2 of them by the incident angle smaller than a total reflection critical angle penetrates this interface B, and carries out incidence to the transparence substrate 1.

[0014] Furthermore, total reflection of the light in which the light which the light which carried out incidence to the transparence substrate 1 from the outgoing radiation lateral electrode 2 penetrated this transparence substrate 1, carried out incidence to the interface C of that front face and open air (air), and carried out incidence by the incident angle smaller than a total reflection critical angle to said interface C among that light refracted for which and carried out outgoing radiation by this interface C and which carried out incidence by the larger incident angle than a total reflection critical angle is carried out by said interface C.

[0015] A part of light of the light which carried out total reflection by this interface C repeats the total reflection in the interface B with the outgoing radiation lateral electrode 2, and reflection by said interface A and the end face of the longitudinal direction of the transparence substrate 1, and the light which refracted and progressed to zigzag and carried out incidence of the inside of

the transparence substrate 1 among that light by the incident angle smaller than a total reflection critical angle to said interface C penetrates this interface C, and they carries out outgoing radiation.

[0016] Moreover, although other light which carried out total reflection by said interface C penetrates the interface B with said outgoing radiation lateral electrode 2, returns to the outgoing radiation lateral electrode 2, or penetrates the interface A with the electroluminescence layer 4 further and returns to the electroluminescence layer 4 The light which refracted and progressed the inside of the outgoing radiation lateral electrode 2 or the electroluminescence layer 4 to zigzag, and carried out incidence to said interfaces A and B of them by the incident angle smaller than a total reflection critical angle carries out incidence of the light to the transparence substrate 1 again as mentioned above. The light which carried out incidence by the incident angle smaller than a total reflection critical angle to the interface C with said open air among the light carries out outgoing radiation.

[0017] That is, in the above-mentioned EL element, incidence is carried out by the incident angle smaller than a total reflection critical angle to the interface A of the electroluminescence layer 4 and the outgoing radiation lateral electrode 2, and the interface B of the outgoing radiation lateral electrode 2 and the transparence substrate 1, these interfaces A and B are penetrated, and the light which carried out incidence by the incident angle smaller than a total reflection critical angle to the interface C of the front face of said transparence substrate 1 and the open air which are an outgoing radiation side further turns into outgoing radiation light.

[0018] In addition, although it progresses while such light is refracted in the electroluminescence layer 4, the outgoing radiation lateral electrode 2, and the transparence substrate 1 as mentioned above although total reflection of other light is carried out in either of the field sides A, B, and C, it is the process, and a part of light carries out outgoing radiation from the end face of said outgoing radiation lateral electrode 2, and the electroluminescence layer 4 and the transparence substrate 1, and turns into leakage light.

[0019] Therefore, the light which finally carries out outgoing radiation to an outgoing radiation side As it is the light which carries out incidence by the incident angle smaller than a total reflection critical angle to the interface C of an outgoing radiation side and the open air and is shown in drawing 7 The include angle to the perpendicular direction (direction in alignment with the perpendicular to an outgoing radiation side) in the interface A with the outgoing

radiation lateral electrode 2 of the light which emitted light in the electroluminescence layer 4 The incident angle alpha If an include angle [as opposed to said perpendicular direction from the incident angle gamma and an outgoing radiation side for an include angle / as opposed to said perpendicular direction in the interface C of the incident angle beta, the transparence substrate 1, and the open air for the include angle to said perpendicular direction in the interface of the outgoing radiation lateral electrode 2 and the transparence substrate 1] is used as the outgoing radiation angle delta Finally the light of the range smaller than 90 degrees is a light which carries out incidence by the following incident angles alpha, beta, and gamma to said interfaces A, B, and C of the light in which the light delta which carries out outgoing radiation from an outgoing radiation side, i.e., an outgoing radiation angle, emitted light in the electroluminescence layer 4.

[0020] If the refractive index of the air which is [refractive index / of the electroluminescence layer 4] 1.45 and the open air about the refractive index of 2.00 and the transparence substrate 1 in the refractive index of 1.60 and the outgoing radiation lateral electrode 2 is set to 1·0008 here The incident angles alpha, beta, and gamma to the field sides A, B, and C where the outgoing radiation angle delta becomes delta<=90 degrees are alpha<=38.7 degrees beta<=30.0 degrees gamma<=43.6 degrees, and a light smaller than 43.6 degrees turns into [the incident angle gamma over an outgoing radiation side] outgoing radiation light among the light which carries out incidence to an outgoing radiation side (the interface C of the front face of the transparence substrate 1, and the open air).

[0021]

[Problem(s) to be Solved by the Invention] However, although the brightness of the light (light of delta= 0 degree of outgoing radiation angles) which carries out outgoing radiation of the above-mentioned conventional EL element in the direction of a transverse plane, i.e., the direction perpendicular to an outgoing radiation side, is high, since the brightness falls rapidly in connection with the outgoing radiation angle delta becoming large, The outgoing radiation angle range where the luminance distribution of outgoing radiation light is strong directive distribution, therefore the outgoing radiation light of high brightness is obtained has the problem of being narrow.

[0022] And although the EL element is used for the back light of the liquid crystal display component in a liquid crystal display etc. The liquid crystal display with which the above-mentioned conventional EL element uses this EL element as said back light since the

luminance distribution of that outgoing radiation light is strong directive distribution If the display is observed from across to a direction perpendicular to an outgoing radiation side, since a screen will become quite dark, the include-angle range which can observe a display with sufficient brightness has the problem of being narrow.

[0023] Then, now, although it considers diffusing the outgoing radiation light of an EL element with a diffusion plate, and making luminance distribution of outgoing radiation light into homogeneity mostly from the former, since the outgoing radiation light of the outgoing radiation angle range of high brightness of an EL element is also diffused and the brightness falls, the brightness of the light which carries out outgoing radiation in the predetermined direction (for example, the direction of a transverse plane) cannot be made high.

[0024] This invention is united and aims at offering the liquid crystal display using that field emitter while it offers what can make high the brightness of the light which carries out outgoing radiation in the predetermined direction as a field emitter which used the EL element, can make large the outgoing radiation angle range where the outgoing radiation light of sufficient brightness is moreover obtained, and can improve the luminance distribution of outgoing radiation light.

[0025]

[Means for Solving the Problem] The field emitter of this invention is characterized by preparing luminance distribution control-section material with the property which the light which the light which carried out incidence toward the predetermined direction among the incident light from the rear face which counters that outgoing radiation side went straight on, carried out [light] outgoing radiation to the front face, and carried out incidence toward other directions is scattered on the outgoing radiation side of an EL element, and carries out outgoing radiation to said front face.

[0026] Namely, the field emitter of this invention is made to carry out outgoing radiation of the light which emits light in an EL element and carries out outgoing radiation to that front face through said luminance distribution control-section material, and according to this field emitter In order to scatter about the light which the light which carried out incidence toward the predetermined direction among the light which carried out outgoing radiation of said EL element, and carried out incidence to luminance distribution control-section material from the rear face went straight on, carried out outgoing radiation to the front face, and carried out incidence toward other directions and to carry out outgoing radiation to said front face, The brightness of the outgoing radiation light

to said predetermined direction can be made high, the outgoing radiation angle range where the outgoing radiation light of sufficient brightness is moreover obtained can be made large, and the luminance distribution of outgoing radiation light can be improved. [0027] The liquid crystal display of this invention arranges said field emitter as that back light behind a liquid crystal display component. Moreover, this field emitter Since the outgoing radiation angle range where the outgoing radiation light of brightness with the brightness of the outgoing radiation light to a predetermined direction sufficient high moreover is obtained is wide, According to this liquid crystal display, the fall of the brightness of the screen when observing that display from across can be lessened, and the include-angle range which can observe a display with sufficient brightness can be made large.

[0028]

[Embodiment of the Invention] The inside of the incident light from the rear face where the field emitter of this invention counters the outgoing radiation side of an EL element as mentioned above in that outgoing radiation side, By preparing luminance distribution control-section material with the property which the light which the light which carried out incidence toward the predetermined direction went straight on, carried out [light] outgoing radiation to the front face, and carried out incidence toward other directions is scattered about, and carries out outgoing radiation to said front face The brightness of the outgoing radiation light to a predetermined direction is made high, the outgoing radiation angle range where the outgoing radiation light of sufficient brightness is moreover obtained is made large, and the luminance distribution of outgoing radiation light is improved.

[0029] In the field emitter of this invention said luminance distribution control-section material It consists of scatter reflection film inserted between the side faces of two or more area pellucida located in a line along the direction of a field, and these area pellucida. If the thing on the field where said scatter reflection film met in said predetermined direction is desirable and considers luminance distribution control-section material as such a configuration The light which carried out incidence to said area pellucida toward the predetermined direction among the light which carries out incidence from the rear face can be made to be able to go straight on, and the light which carried out incidence toward other directions can be scattered about with said scatter reflection film.

[0030] Moreover, as for said luminance distribution control-section material, it is desirable to stick the rear face to the outgoing radiation side of an EL element,

and to prepare it, the refractive index of said area pellucida is almost the same as the refractive index by the side of the outgoing radiation of said EL element, or it is still more desirable that it is a value near it.

[0031] Thus, while the rear face of said brightness distribution control member has stuck to the outgoing radiation side of an EL element, the refractive index of said area pellucida is almost the same as the refractive index by the side of the outgoing radiation of an EL element, or if it is a value near it, since the light which carried out outgoing radiation will carry out incidence of the EL element to a brightness distribution control member efficiently, outgoing radiation of the light which emitted light in the EL element can be carried out at high effectiveness, and the outgoing radiation light of high brightness can be obtained.

[0032] Moreover, although an organic EL device is sufficient as said EL element, and depression of partial brightness arises in the luminance distribution of the outgoing radiation light from an EL element corresponding to the generating part of said dark spot when a dark spot peculiar to an organic EL device occurs in that case Since the light which carries out outgoing radiation to the front face of said brightness distribution control member turns into light of luminance distribution which had depression of said brightness canceled by dispersion, even if a dark spot occurs in an EL element, it can carry out outgoing radiation of the light of good luminance distribution without depression of partial brightness.

[0033] Especially this is effective in the liquid crystal display which uses said field illuminant as a back light, and since according to this liquid crystal display the light of luminance distribution which had depression of brightness canceled carries out incidence to a liquid crystal display component even if a dark spot occurs in the EL element of said field illuminant, it can display the image of high quality without the brightness fall of the pixel corresponding to the generating part of said dark spot.

[0034]

[Example] Drawing 1 is the sectional view which omitted hatching of the field illuminant by the 1st example of this invention. This field emitter forms the luminance distribution control-section material 20 which had the property which the light which the light which carried out incidence toward the predetermined direction among the incident light from the rear face which counters that outgoing radiation side went straight on, carried out [light] outgoing radiation to the front face, and carried out incidence toward other directions is scattered about, and carries out outgoing radiation to said front face in the outgoing radiation side of EL element 10.

[0035] First, if EL element 10 is explained, this EL element body 10 is the organic EL device which made the electroluminescence layer 14 which consists of an organic material intervene between the transparent outgoing radiation lateral electrode 12 formed in one field of the transparence substrate 11 which consists of glass, and this outgoing radiation lateral electrode 12 and the background electrode 13 which counters, and that outgoing radiation lateral electrode 12 is used as an anode, and let the background electrode 13 be a cathode.

[0036] In addition, said outgoing radiation lateral electrode 12 consists of ITO, or an indium and a zincic acid ghost, and said background electrode 13 is formed with Mg system alloys, such as a Mg-In alloy or a Mg-Ag alloy with a small work function.

[0037] However, since said Mg system alloy has high reactivity, it has a possibility of the background electrode 13 which consists of this Mg system alloy reacting with the moisture in air, and deteriorating, or reacting with oxygen and oxidizing.

[0038] Therefore, in this example, as shown in drawing 1 , the perimeter of said EL element 10 was covered with the airtight high resin film 15 over the inferior surface of tongue of the transparence substrate 11 from that whole rear face, and the background electrode 13 which consists of said Mg system alloy is completely covered from air.

[0039] Moreover, although drawing 1 showed said electroluminescence layer 14 as one layer, this electroluminescence layer 14 has 3 layer structures which carried out the laminating of the electron hole transportation layer to the anode side on both sides of the two-layer structure which carried out the laminating of the electron hole transportation layer to the anode side of an electronic transportability luminous layer, or a luminous layer, and carried out the laminating of the electronic transportation layer to the cathode side.

[0040] When making the electroluminescence layer 14 into 3 layer structures, for example, in addition, a luminous layer DPVBi {a 4 and 4'-screw (2 and 2-diphenyl vinylene) biphenyl} and BCz VBi {a 4 and 4'-screw (2-carbazole vinylene) biphenyl} It forms by the polymeric materials which mixed DPVBi 96% of the weight, and mixed BCz VBi at 4% of the weight of a rate. An electron hole transportation layer It forms by alpha-NPD {N, N'-JI (alpha-naphthyl)-N, and N'-diphenyl -1 and 1'-biphenyl-4,4'-diamine}, and an electronic transportation layer is formed by Alq3 {tris(8-hydroxyquinoline)-ized aluminum}.

[0041] The refractive indexes of the layer by the side of the outgoing radiation of said electroluminescence layer 14, i.e.,

the refractive index of the electron hole transportation layer which consists of alpha-NPD, are 1.40-1.80, and, in the case of ITO, the refractive indexes of about 2.00 and the transparence substrate (glass) 1 of the refractive index of the outgoing radiation lateral electrode 12 are 1.45-1.80.

[0042] If this EL element 10 impresses an electrical potential difference (direct current voltage) between that outgoing radiation lateral electrode 12 and background electrode 13, a luminescence drive is carried out and an electrical potential difference is impressed between these two electrodes 12 and 13, an electron is injected into the electroluminescence layer 14 for an electron hole from the background electrode (cathode) 13 from the outgoing radiation lateral electrode (anode) 12, a singlet exciton will occur by the recombination of that electron hole and electron that were poured in, and it will emit light.

[0043] And incidence of the light by this singlet exciton is carried out to the outgoing radiation lateral electrode 12 from the electroluminescence layer 14, and it penetrates the transparence substrate 11 further and it carries out outgoing radiation to that front face. In addition, although there is also light which goes to the rear-face side of the electroluminescence layer 14 among the light which said singlet exciton emits, the light is reflected with the background electrode 13.

[0044] In addition, the luminous layer which said electroluminescence layer 14 turns into from Above DPVBi and BCz VBi, When it is 3 layer structures which carried out the laminating of the electron hole transportation layer which consists of alpha-NPD, and the electronic transportation layer which consists of Alq3, the light which emits light in this electroluminescence layer 14 Although all the wavelength of a light band is included, it is the light of a wavelength component with much [a little] quantity of light of the wavelength region of the blue of them, therefore the luminescent color turns into a color which wore blueness.

[0045] Then, he is trying to bring the color of the light which carries out outgoing radiation of said EL element 10 close to white in this example by distributing a red fluorescent material and a green fluorescent material optimum dose every, making said fluorescent material absorb a part of light which emitted light, and generating green fluorescence with red in the luminous layer of said electroluminescence layer 14, or the electron hole transportation layer by the side of outgoing radiation.

[0046] Next, the above-mentioned luminance distribution control-section material 20 is explained. Drawing 2 is the perspective view of said brightness

distribution control member 20. This luminance distribution control-section material 20 consists of a film which was inserted between two or more area pellucida 21 located in a line along that direction of a field, and the side face of these area pellucida 21 and which each both sides come out and consists of a certain scatter reflection film 22, and said scatter reflection film 22 is on the field which met in the predetermined direction. Hereafter, this luminance distribution control-section material 20 is called luminance distribution control film.

[0047] In addition, the diffusibility film which consists of a sintered compact of metallic oxides, such as reflexibility microcrystal film, such as inorganic metals, such as aluminum or silver, and an organic metal containing a polyacethylene derivative, and titanium oxide, a zinc oxide, an aluminum oxide, a magnesium oxide, as said scatter reflection film 22 is used.

[0048] This luminance distribution control film 20 is on the field where said scatter reflection film 22 met in the direction perpendicular to a film plane, and this luminance distribution control film 20 is making the shape of a louver mutually located in a line in parallel at spacing at which the straight-line-like scatter reflection film 22 which met one of crosswise [those / in every direction] is equivalent to the width of face of said area pellucida 21.

[0049] In addition, the luminance distribution control film 20 of the shape of this louver carries out the laminating of the transparent resin layer and said scatter reflection film 22 of the thickness equivalent to the width of face of said area pellucida 21 by turns, and can manufacture them by the approach of slicing that laminating Grock in the shape of a film along with a cutting plane perpendicular to the thickness direction (the direction of a laminating).

[0050] Moreover, the refractive index of the area pellucida 21 of said luminance distribution control film 20 is almost the same as the refractive index by the side of the outgoing radiation of above-mentioned EL element 10 (this example refractive index of the transparence substrate 11), or it consists of transparence resin which is a value near it.

[0051] In addition, although the refractive indexes by the side of the outgoing radiation of EL element 10, i.e., the refractive index of the transparence substrate 11 which consists of glass, are 1.45-1.80, it is almost the same as it, or as transparence resin with the refractive index of a near value, there are PET (polyethylene terephthalate), PES (polyether ape phon), a PC (polycarbonate), etc., and the refractive indexes of these resin are 1.40-1.60.

[0052] And said luminance distribution control film 20 makes the outgoing

radiation side of above-mentioned EL element 10 stick a film rear face to the outgoing radiation side (front face of the transparence substrate 11) of EL element 10, and is prepared in it. In addition, in this example, it is almost the same as one of the refractive index of that area pellucida 21, and the refractive indexes of the transparence substrate 11 of EL element 10 in the brightness distribution control film 20, or EL element 10 is pasted with transparence adhesives (not shown) with the refractive index between both refractive indexes.

[0053] The above-mentioned field emitter is made to carry out outgoing radiation of the light which emits light in the electroluminescence layer 14 of EL element 10, and carries out outgoing radiation to the front face of EL element 10 through said luminance distribution control film 20.

[0054] First, although the light from this point will emit it toward various directions as an arrow shows to drawing 1 if the outgoing radiation path on the front face of an EL element of the light which emitted light in the electroluminescence layer 14 of EL element 10 is seen about the light from one point of said electroluminescence layer 14 Among those, the light which goes in the direction (direction in alignment with the perpendicular to an outgoing radiation side) perpendicular to the outgoing radiation side of EL element 10 Interface A' of the electroluminescence layer 14 and the outgoing radiation lateral electrode 12 and interface B' of said outgoing radiation lateral electrode 12 and transparence substrate 11 are penetrated without producing refraction and reflection, and carry out outgoing radiation at right angles to an EL element front face.

[0055] On the other hand, although incidence of the synchrotron orbital radiation which goes in the direction of slant is aslant carried out to said field side A' and B', since the refractive indexes of the layer which the refractive index of said electroluminescence layer 14 and outgoing radiation lateral electrode 12, and the transparence substrate 11 is the value which was mentioned above, and adjoins each other differ mutually, the synchrotron orbital radiation which goes in said direction of slant is refracted or reflected by said field side A' and B'.

[0056] That is, total reflection of the light which the light which carried out incidence of the synchrotron orbital radiation which goes in the direction of slant to interface A' of the electroluminescence layer 14 and the outgoing radiation lateral electrode 12 first, and carried out incidence by the incident angle smaller than a total reflection critical angle to said interface A' among that light was refracted by this interface A', carried out incidence into the

outgoing radiation lateral electrode 12, and carried out incidence by the larger incident angle than a total reflection critical angle is carried out by said interface A'.

[0057] In addition, while being reflected with the background electrode 13, it reflects by the end face of said interface A' and the electroluminescence layer 14, and the light which it refracts and progresses to zigzag, is that process, and carried out incidence of the inside of the electroluminescence layer 14 to said interface A' by the incident angle smaller than a total reflection critical angle penetrates this interface A', and carries out incidence of the light which carried out total reflection by said interface A' into the outgoing radiation lateral electrode 2.

[0058] Moreover, total reflection of the light which the light which the light which carried out incidence to the outgoing radiation lateral electrode 12 penetrated the inside of this outgoing radiation lateral electrode 12, carried out incidence to interface B' with the transparence substrate 11, and carried out incidence by the incident angle smaller than a total reflection critical angle to said interface B' among that light was refracted by this interface B', carried out incidence into the transparence substrate 11, and carried out incidence by the larger incident angle than a total reflection critical angle is carried out by interface B'.

[0059] A part of light of the light which carried out total reflection by this interface B' repeats reflection by the end face of the longitudinal direction of the total reflection in interface A' with the electroluminescence layer 14, said interface B', and the outgoing radiation lateral electrode 12, and the light which refracted and progressed to zigzag and carried out incidence of the inside of the outgoing radiation lateral electrode 12 to said interface B' by the incident angle smaller than a total reflection critical angle among that light penetrates this interface B', and carries out incidence of them to the transparence substrate 11.

[0060] Moreover, although other light which carried out total reflection by said interface B' penetrates interface A' with said electroluminescence layer 14 and returns to the electroluminescence layer 14 The light refracts and progresses the inside of the electroluminescence layer 14 to zigzag by above-mentioned interface A' like the light which carried out total reflection, and is the process. The light which the light which carried out incidence to said interface A' by the incident angle smaller than a total reflection critical angle penetrated this interface A', carried out incidence to the outgoing radiation lateral electrode 2, and carried out incidence to interface B' with the outgoing radiation lateral electrode 2 of them by the incident angle

smaller than a total reflection critical angle penetrates this interface B', and carries out incidence to the transparence substrate 11.

[0061] And the light which carried out incidence to the transparence substrate 11 from the outgoing radiation lateral electrode 12 penetrates this transparence substrate 11, it carries out outgoing radiation to that front face, and it carries out incidence to the area pellucida 21 of the above-mentioned luminance distribution control film 20 from that rear face.

[0062] In this case, while making into the value near it whether to be almost the same as the refractive index by the side of the outgoing radiation of EL element 10 (refractive index of the transparence substrate 11) in the refractive index of the area pellucida 21 of said luminance distribution control film 20 in this example This luminance distribution control film 20 [whether it is almost the same as one of the refractive index of that area pellucida 21, and the refractive indexes of the transparence substrate 11 of EL element 10, and] Or since EL element 10 is pasted with the transparence adhesives with the refractive index between both refractive indexes which are not illustrated, No matter the incident angle may be what include angle, without the most carrying out total reflection, the light which carried out incidence to interface C' of the front face of EL element 10 and the luminance distribution control film 20 penetrates said interface C', and it carries out incidence to the area pellucida 21 of the luminance distribution control film 20.

[0063] Next, if the outgoing radiation path of the light which carried out incidence to the area pellucida 21 of said luminance distribution control film 20 is explained The direction which met the scatter reflection film 22 among the light which carried out incidence to this area pellucida 21 from that rear face, That is, the light (light which carried out outgoing radiation perpendicularly from EL element 10) which carried out incidence toward the direction perpendicular to the film plane of the luminance distribution control film 20 goes straight on, and carries out outgoing radiation of said area pellucida 21 at right angles to the front face of the luminance distribution control film 20.

[0064] On the other hand, the light which carried out incidence to said area pellucida 21 toward other directions, i.e., the light which carried out incidence aslant to the film plane of the luminance distribution control film 20, penetrates the area pellucida 21 aslant, it carries out incidence to the scatter reflection film 22 of the side face, and they is scattered about in the dispersion reflector.

[0065] In addition, the light which arrives at the front face of the area pellucida 21

as it is, without carrying out incidence to said scatter reflection film 22 is also in the light which penetrates said area pellucida 21 aslant, and outgoing radiation of the light is carried out to the front face of the luminance distribution control film 20, without being scattered about. In interface D' of the front face of the area pellucida 21, and the open air, this outgoing radiation light is refracted according to the refractive-index difference of the incident angle over this interface D', and said area pellucida 21 and open air (air), and carries out outgoing radiation in that direction.

[0066] The light scattered about by said scatter reflection film 22 progresses the inside of the area pellucida 21 toward various directions, and the light which goes to the front face of the area pellucida 21 of them carries out incidence to interface D' with said open air.

[0067] In addition, the most carries out incidence of the light which carried out incidence to said area pellucida 21 in order that the light which most of the light carries out incidence to the scatter reflection film 22 of the opposite side although incidence of the light which goes in other directions is not directly carried out to said interface D', and is scattered about again, and goes to the front face of the area pellucida 21 of the scattered light might carry out incidence to said interface D' to said interface D'.

[0068] And the light which carried out incidence to interface D' of the front face of said area pellucida 21 and the open air by the incident angle smaller than a total reflection critical angle to said interface D' among the light which carried out incidence penetrates this interface D', and it carries out outgoing radiation to the front face of the luminance distribution control film 20. In said interface D', this outgoing radiation light is refracted according to the refractive-index difference of the incident angle over this interface D', and said area pellucida 21 and open air (air), and carries out outgoing radiation in that direction.

[0069] Moreover, although total reflection of the light which carried out incidence to said interface D' by the larger incident angle than a total reflection critical angle is carried out by this interface D', since incidence of it is carried out to the scatter reflection film 22 of that reflective direction and it is scattered about again, finally incidence of that light is carried out to said interface D' by the incident angle smaller than a total reflection critical angle, such light also penetrates this interface D' and it carries out outgoing radiation to the front face of the luminance distribution control film 20.

[0070] Thus, the inside of the light which according to the above-mentioned field emitter carried out outgoing radiation of EL element 10, and carried out incidence to the luminance distribution control film

20 from the rear face, In order to scatter about the light which the light which carried out incidence toward the perpendicular direction went straight on, carried out outgoing radiation to the front face, and carried out incidence toward other directions and to carry out outgoing radiation to said front face, The brightness of the outgoing radiation light to said perpendicular direction can be made high, the outgoing radiation angle range where the outgoing radiation light of sufficient brightness is moreover obtained can be made large, and the luminance distribution of outgoing radiation light can be improved.

[0071] In addition, the light which carries out incidence at right angles to interface D' of the front face of said luminance distribution control film 20 and the open air is also in the light scattered about in the luminance distribution control film 20, and in order to carry out outgoing radiation of the light perpendicularly, without being refracted by said interface D', the brightness of the outgoing radiation light to said perpendicular direction becomes still higher than the brightness of the rectilinear-propagation light which penetrates the luminance distribution control film 20 perpendicularly, and carries out outgoing radiation to a front face.

[0072] And the inside of the light which according to the above-mentioned field emitter carried out outgoing radiation of EL element 10, and carried out incidence to each area pellucida 21 of the luminance distribution control film 20, The light which progresses by the larger incident angle than a total reflection critical angle toward interface D' of the front face of said area pellucida 21 and the open air which are a final outgoing radiation side is scattered about, and a direction is changed. Since that light carries out incidence to said interface D' by the incident angle smaller than a total reflection critical angle and outgoing radiation of this interface D' is penetrated and carried out, outgoing radiation effectiveness of the light which carried out incidence to the brightness distribution control film 20 from EL element 10 can be made high.

[0073] In furthermore, the process which progresses while the light which carried out total reflection in respect of [A, B and C] each field is refracted in the conventional EL element in the electroluminescence layer 4, the outgoing radiation lateral electrode 2, and the transparence substrate 1, as shown in drawing 7 Although the loss of the light in a process until it carries out outgoing radiation of the EL element is large, therefore the outgoing radiation quantity of light decreases considerably compared with the luminescence energy in the electroluminescence layer 4 since a part of the light carries out outgoing radiation from the end face of said outgoing

radiation lateral electrode 2, and the electroluminescence layer 4 and the transparence substrate 1 and turns into leakage light According to the above-mentioned field emitter, there are also few losses of the light in a process until it carries out outgoing radiation of EL element 10.

[0074] Namely, although a part of the light carries out outgoing radiation from the end face of said outgoing radiation lateral electrode 2, and the electroluminescence layer 4 and the transparence substrate 1 and turns into leakage light also in the above-mentioned field emitter in the process which progresses while the light which carried out total reflection by interface A' and B' is refracted in the electroluminescence layer 14 and the outgoing radiation lateral electrode 12 as shown in drawing 1 As mentioned above, no matter the incident angle over interface C' of the transparence substrate 11 and the luminance distribution control film 20 may be what include angle, the light which carried out incidence to the transparence substrate 11 In order to penetrate said interface C' and to carry out incidence to the area pellucida 21 of the luminance distribution control film 20, without the most carrying out total reflection, the leakage light from the end face of a transparence substrate like the conventional EL element is hardly produced.

[0075] Therefore, according to the above-mentioned field light emitting device, the quantity of light which carries out outgoing radiation of EL element 10, and penetrates and carries out outgoing radiation of the brightness distribution control film 20 further can be made [many] by leaps and bounds compared with the outgoing radiation quantity of light of the conventional EL element (more than twice [at least]), and the outgoing radiation light of high brightness can be obtained.

[0076] Drawing 3 is drawing showing the luminance distribution of the outgoing radiation light of the above-mentioned field emitter in the luminance distribution of the conventional EL element, and the outgoing radiation side of the EL element as compared with luminance distribution when the diffusion plate has been arranged, and the continuous line shows luminance distribution when the luminance distribution of the field emitter of the above-mentioned example, the luminance distribution of the EL element of the former [broken line], and an alternate long and short dash line have arranged the diffusion plate to the outgoing radiation side of the conventional EL element.

[0077] In addition, the luminance distribution of the above-mentioned field emitter shown in drawing 3 It is perpendicular to the outgoing radiation

side (front face of the luminance distribution control film 20) of a field emitter, and are the luminance distribution on the field which met in the direction which intersects perpendicularly to the area pellucida 21 of the luminance distribution control film 20, and the die-length direction of the scatter reflection film 22, and it sets to drawing. + The outgoing radiation angle of the light which carries out outgoing radiation of theta in one direction to a direction (the direction of theta= 0 degree of outgoing radiation angles) perpendicular to an outgoing radiation side, and -theta are the outgoing radiation angles of the light which carries out outgoing radiation to an opposite direction to said perpendicular direction.

[0078] Like this drawing 3 , although the brightness of the light which carries out outgoing radiation of the luminance distribution of the conventional EL element in the direction of a transverse plane (direction perpendicular to an outgoing radiation side) is high, the outgoing radiation angle range to which that brightness falls rapidly in connection with an outgoing radiation angle becoming large and where it is strong directive distribution, therefore the outgoing radiation light of high brightness is obtained is narrow.

[0079] Moreover, although it is almost uniform distribution, since luminance distribution when the diffusion plate has been arranged to the outgoing radiation side of the conventional EL element also diffuses the outgoing radiation light of the outgoing radiation angle range of high brightness of an EL element, the brightness of the light which carries out outgoing radiation in the direction of a transverse plane is quite low [luminance distribution] compared with the conventional EL element.

[0080] It compares with these. The luminance distribution of the field emitter of the above-mentioned example The brightness of the outgoing radiation light to the direction of a transverse plane is distribution with the wide outgoing radiation angle range where the outgoing radiation light of sufficient brightness is obtained high moreover. And in order to carry out outgoing radiation also of the light which carried out incidence at right angles to interface D' with the open air of the light scattered about in said luminance distribution control film 20 perpendicularly besides the rectilinear-propagation light which penetrates the luminance distribution control film 20 perpendicularly, and carries out outgoing radiation to a front face, The brightness of the light which carries out outgoing radiation in the direction of a transverse plane is still higher than the conventional EL element.

[0081] Moreover, the organic EL device equipped with the electroluminescence layer 14 which consists of a conductive

polymer as the EL element 10 is used for the field emitter of the above-mentioned example, and since the permeability of an organic EL device of the light of the electroluminescence layer 14 is high, it can carry out outgoing radiation of the light which emitted light efficiently.

[0082] Moreover, since, as for said organic EL device, the electroluminescence layer 14 consists of an organic material, If the poor luminescence part called a dark spot to an interface with the outgoing radiation lateral electrode 12 which consists of this electroluminescence layer 14 and metallic material may occur and this dark spot occurs Although depression of partial brightness arises in the luminance distribution of the outgoing radiation light from EL element 10 corresponding to the generating part of said dark spot The light which carries out outgoing radiation to the front face of said luminance distribution control film 20 Since it is the light of luminance distribution which had depression of said brightness canceled by dispersion, According to the above-mentioned field emitter, even if a dark spot peculiar to an organic EL device occurs in EL element 10 Since it becomes the light of luminance distribution which had depression of brightness canceled, even if a dark spot occurs in EL element 10, outgoing radiation of the light of good luminance distribution without depression of partial brightness can be carried out.

[0083] Drawing 4 is the sectional view which omitted hatching of the field illuminant by the 2nd example of this invention. The field emitter of this example makes the transparence substrate of EL element 10 serve a double purpose with the luminance distribution control film 20, and the fundamental structure of EL element 10 and the structure of the luminance distribution control film 20 are the same as the 1st example of the above.

[0084] However, in this example, a refractive index is almost the same as the refractive index by the side of the outgoing radiation of EL element 10 (refractive index of the electron hole transportation layer which is a layer by the side of that outgoing radiation when making the electroluminescence layer 14 into 3 layer structures), or forms the area pellucida 21 of said luminance distribution control film 20 by the transparence resin which is a value near it.

[0085] According to the field emitter of this example, no matter that incident angle may be what include angle, the light which carries out outgoing radiation of EL element 10, i.e., the light which carried out incidence to the interface of EL element 10 and the luminance distribution control film 20 In order to penetrate said interface and to carry out incidence to the area pellucida 21 of the

luminance distribution control film 20, without carrying out total reflection, The total reflection in the process in which the light which emitted light in the electroluminescence layer 14 of EL element 10 carries out outgoing radiation of EL element 10 The leakage of the light which only occurs in drawing 4 in the interface of the electroluminescence layer 14 and the outgoing radiation lateral electrode 12, therefore carried out total reflection of the outgoing radiation path to it as the arrow showed Since it becomes only leakage from the end face of the electroluminescence layer 14 mostly, the outgoing radiation quantity of light can be further made [many] rather than the 1st example of the above.

[0086] In addition, although the thing on the field where the scatter reflection film 22 met in the direction perpendicular to a film plane as a luminance distribution control film 20 was used in the 1st and 2nd examples of the above, the dispersion reflector of said scatter reflection film 22 may be an inclined plane.

[0087] The inside of the light which carried out outgoing radiation of the EL element, and carried out incidence to the luminance distribution control film from the rear face when using such a luminance distribution control film, In order to scatter about the light which the light which carried out incidence toward the direction which met the scatter reflection film 22 went straight on, and carried out outgoing radiation to the front face and which carried out incidence toward other directions and to carry out outgoing radiation to said front face, The brightness of the outgoing radiation light to the direction of slant can be made high, the outgoing radiation angle range where the outgoing radiation light of sufficient brightness is moreover obtained can be made large, and the luminance distribution of outgoing radiation light can be improved.

[0088] Moreover, although the thing which made the distributed condition contain the fluorescent material which emits red fluorescence to the luminous layer which emits a blue light as an electroluminescence layer 14, and the fluorescent material which emits green fluorescence was used in the above-mentioned example The luminous layer of the shape of a dot which emits the light of not only this but red, the luminous layer of the shape of a dot which emits a green light, and the luminous layer of the shape of a dot which emits a blue light are arranged in by turns, are formed, and it may be made to make the color of the light which carries out outgoing radiation of EL element 10 into white.

[0089] Furthermore, although the brightness distribution control film 20 of the shape of a louver mutually located in a line in parallel at spacing at which the straight-line-like scatter reflection film

22 is equivalent to the width of face of the area pellucida 21 as a brightness distribution control member prepared in the outgoing radiation side of EL element 10 was used in the above-mentioned example That from which what prepared the scatter reflection film in the shape of a grid into the transparent film prepared the scatter reflection film with short die length in the suitable pitch for the dip direction and the direction of breadth into the bright film is sufficient as said luminance distribution control-section material.

[0090] Drawing 5 is the perspective view showing the modification of a brightness distribution control member, and this brightness distribution control member makes the die-length direction of two sheets and each scatter reflection film 22 intersect perpendicularly mutually, and piles up the louver-like brightness distribution control film 20 used in the above-mentioned example.

[0091] If such a brightness distribution control member is used, since the scatter reflection film 22 is formed in the shape of a grid and incident light is scattered about in the two directions which intersect perpendicularly mutually, luminance distribution of the outgoing radiation light of said two directions can be made distribution respectively like drawing 3 .

[0092] In addition, the above-mentioned luminance distribution control-section material should just have the property which the light which the light which carried out incidence toward the predetermined direction not only among what prepared the scatter reflection film into the transparent film but among the incident light from a rear face went straight on, carried out [light] outgoing radiation to the front face, and carried out incidence toward other directions is scattered about, and carries out outgoing radiation to said front face.

[0093] Next, the liquid crystal display using the above-mentioned field emitter is explained. Drawing 6 is the side elevation showing one example of said liquid crystal display, and this liquid crystal display arranges the field emitter mentioned above as that back light 36 behind the liquid crystal display component 30.

[0094] The above-mentioned liquid crystal display component 30 is an ECB (birefringence effectiveness) mold liquid crystal display component of a simple matrix or an active-matrix method, and it arranges polarizing plates 34 and 35 on the external surface of said substrates 31 and 32, respectively while it prepares the liquid crystal layer in which the liquid crystal molecule changed orientation into the predetermined orientation condition (for example, twist orientation condition) between the transparent electrode formation substrate 31 of a pair joined through the frame-like sealant 33, and 32.

[0095] This ECB mold liquid crystal display component 30 is what obtains coloring light using a birefringence operation of a liquid crystal layer and the polarization of polarizing plates 34 and 35. Each wavelength light turns into light used as the elliptically polarized light from which a polarization condition differs, respectively according to a birefringence operation of liquid crystal in the process in which the linearly polarized light which penetrated and carried out incidence of one polarizing plate penetrates a liquid crystal layer, and the light carries out incidence to the polarizing plate of another side. The light which penetrated the polarizing plate of this another side turns into coloring light of a color according to the ratio of the optical reinforcement of each wavelength light which constitutes that light.

[0096] That is, since this ECB mold liquid crystal display component 30 obtains coloring light, without using a color filter and does not have the absorption of light according [therefore] to a color filter, it can make the permeability of light high and can obtain bright color display.

[0097] And the form birefringence of liquid crystal changes with the orientation conditions of the liquid crystal molecule according to the electrical potential difference on which the ECB mold liquid crystal display component 30 is impressed to inter-electrode [of both the substrates 31 and 32]. Since the polarization condition of each wavelength light which carries out incidence to the polarizing plate of another side according to it changes, by controlling applied voltage, the color of coloring light can be changed, two or more colors by the same pixel can be displayed, and multicolor color pictures, such as a full color image, can be displayed.

[0098] Moreover, in this example, the field emitter of the 1st example shown in drawing 1 is used as said back light 36. Explanation of the configuration of this field emitter attaches and omits a same sign to drawing.

[0099] Since the field emitter with the wide outgoing radiation angle range where the outgoing radiation light of brightness with the brightness of the outgoing radiation light to a predetermined direction which was mentioned above sufficient high moreover is obtained as a back light 36 of that liquid crystal display component 30 is used for this liquid crystal display, it can lessen the fall of the brightness of the screen when observing that display from across, and can make large the include-angle range which can observe a display with sufficient brightness.

[0100] And since the above-mentioned field emitter has much quantity of light which carries out outgoing radiation of EL element 10, and penetrates and carries out outgoing radiation of the

brightness distribution control film 20 further by leaps and bounds compared with the outgoing radiation quantity of light of the conventional EL element, it can carry out incidence of the light of high brightness to the liquid crystal display component 30, and can display the image of high brightness.

[0101] Moreover, since the above-mentioned liquid crystal display can use the above-mentioned field emitter for a back light 36 and can reflect light with the background electrode 13 of EL element 10 which is the source of luminescence of this field emitter, It is also possible to make it reflect in drawing 6 with the background electrode 13 of said EL element 10, and to display on it the outdoor daylight (natural light or indoor illumination light) which carries out incidence from the outgoing radiation side side of the liquid crystal display component 30, without carrying out the luminescence drive of said EL element 10, as a broken line shows. Therefore, it can be used as the so-called 2-way display which can perform both the transparency mold display using the light from a back light 36, and the reflective mold display using outdoor daylight.

[0102] In this case, since the field emitter of the above-mentioned example uses an organic EL device with the high permeability of the light of that electroluminescence layer 14 for EL element 10, when performing a reflective mold display, it reflects efficiently the outdoor daylight which carried out incidence with the background electrode 13, and it not only can carry out outgoing radiation of the light which emitted light efficiently, but can obtain a bright display.

[0103] Moreover, should make each of that scatter reflection film 22 correspond, respectively between the spacing of each pixel of the liquid crystal display component 30, and a train, and the luminance distribution control film 20 of said field emitter should be formed in the shape of a grid. If the black mask corresponding to the scatter reflection film 22 of the shape of said grid is prepared in said liquid crystal display component 30, while being able to prevent a flicker of the display by the light reflex of scatter reflection film 22 the very thing, incidence of the outgoing radiation light from EL element 10 can be efficiently carried out to each pixel of the liquid crystal display component 30.

[0104] In addition, although said EL element 10 may generate a dark spot peculiar to an organic EL device, even in such a case, the outgoing radiation light (light which carries out outgoing radiation to the front face of a brightness distribution control member) from a field emitter can carry out incidence of the light of the good luminance distribution which does not have depression of partial brightness since it becomes the light of luminance distribution which had

depression of said brightness canceled by dispersion to the liquid crystal display component 30, and it can display the image of high quality.

[0105] And in this liquid crystal display, since the ECB mold liquid crystal display component which obtains coloring light as a liquid crystal display component 30, without using a color filter is used, a color picture bright enough can be displayed also in the reflective mold display using outdoor daylight.

[0106] Moreover, since said ECB mold liquid crystal display component 30 is what obtains coloring light using a birefringence operation of a liquid crystal layer and the polarization of polarizing plates 34 and 35, For example, even if it is going to change the color of each pixel to red, green, and blue and is going to display a full color image If the fluorescent material which emits the fluorescence of the color corresponding to the color from which high color purity cannot obtain all foreground colors easily with the ECB mold liquid crystal display component 30 although not necessarily obtained by high color purity is added in the electroluminescence layer 14 of above-mentioned EL element 10, the good color picture of color balance can be displayed.

[0107] In addition, although the liquid crystal display component 30 used for the liquid crystal display of the above-mentioned example is the thing of an ECB mold, as for the case of the display using the light from the field emitter which is a back light 36 only for transparency molds, said liquid crystal display component 30 may display a color picture using a color filter.

[0108]

[Effect of the Invention] The inside of the incident light from the rear face where the field emitter of this invention counters the outgoing radiation side of an EL element in that outgoing radiation side, Since luminance distribution control-section material with the property which the light which the light which carried out incidence toward the predetermined direction went straight on, carried out [light] outgoing radiation to the front face, and carried out incidence toward other directions is scattered about, and carries out outgoing radiation to said front face is prepared The brightness of the light which carries out outgoing radiation in the predetermined direction can be made high, the outgoing radiation angle range where the outgoing radiation light of sufficient brightness is moreover obtained can be made large, and the luminance distribution of outgoing radiation light can be improved.

[0109] In the field emitter of this invention said luminance distribution control-section material It consists of scatter reflection film inserted between the side faces of two or more area pellucida located in a line along the

direction of a field, and these area pellucida. If the thing on the field where said scatter reflection film met in said predetermined direction is desirable and considers luminance distribution control-section material as such a configuration The light which carried out incidence to said area pellucida toward the predetermined direction among the light which carries out incidence from the rear face can be made to be able to go straight on, and the light which carried out incidence toward other directions can be scattered about with said scatter reflection film.

[0110] Moreover, as for said luminance distribution control-section material, it is desirable to stick the rear face to the outgoing radiation side of an EL element, and to prepare it, the refractive index of said area pellucida is almost the same as the refractive index by the side of the outgoing radiation of said EL element, or it is still more desirable that it is a value near it. If it does in this way, since the light which carried out outgoing radiation will carry out incidence of the EL element to a brightness distribution control member efficiently, outgoing radiation of the light which emitted light in the EL element can be carried out at high effectiveness, and the outgoing radiation light of high brightness can be obtained.

[0111] Moreover, although an organic EL device is sufficient as said EL element, and depression of partial brightness arises in the luminance distribution of the outgoing radiation light from an EL element corresponding to the generating part of said dark spot when a dark spot peculiar to an organic EL device occurs in that case, the light which carries out outgoing radiation to the front face of said luminance distribution control-section material turns into light of luminance distribution which had depression of said brightness canceled by dispersion.

[0112] The liquid crystal display of this invention arranges said field emitter as that back light behind a liquid crystal display component. Moreover, this field emitter Since the outgoing radiation angle range where the outgoing radiation light of brightness with the brightness of the outgoing radiation light to a predetermined direction sufficient high moreover is obtained is wide, According to this liquid crystal display, the fall of the brightness of the screen when observing that display from across can be lessened, and the include-angle range which can observe a display with sufficient brightness can be made large.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The sectional view which omitted hatching of the field illuminant by the 1st example of this invention.

[Drawing 2] The perspective view of the luminance distribution control-section

material used for said field emitter.

[Drawing 3] Drawing showing the luminance distribution of the outgoing radiation light of said field emitter in the luminance distribution of the conventional EL element, and the outgoing radiation side of the EL element as compared with luminance distribution when the diffusion plate has been arranged.

[Drawing 4] The sectional view which omitted hatching of the field illuminant by the 2nd example of this invention.

[Drawing 5] The perspective view showing the modification of luminance distribution control-section material.

[Drawing 6] The side elevation showing one example of the liquid crystal display of this invention.

[Drawing 7] The sectional view which omitted hatching of the conventional EL element.

[Description of Notations]

10 -- EL element

11 -- Transparence substrate

12 -- Outgoing radiation lateral electrode

13 -- Background electrode

14 -- Electroluminescence layer

20 -- Luminance distribution control-section material

21 -- Area pellucida

22 -- Scatter reflection film

30 -- Liquid crystal display component

36 -- Back light (field emitter)

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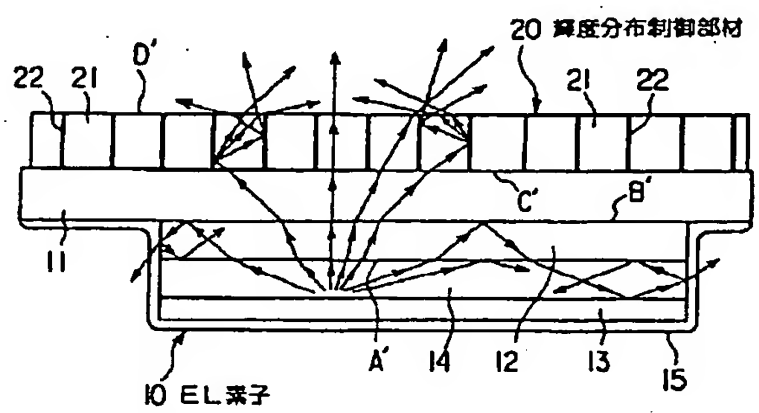
(54)【発明の名称】　面発光体およびそれを使用する液晶表示装置

(57)【要約】

【課題】ＥＬ素子を用いた面発光体として、所定の方向に出射する光の輝度を高くし、しかも充分な輝度の出射光が得られる出射角範囲を広くして出射光の輝度分布を改善することができるものを提供する。

【解決手段】ＥＬ素子１０の出射面に、面方向に沿って並ぶ複数の透明部２１とこれらの透明部の側面の間に挟まれた散乱反射膜２２とからなる輝度分布制御部材２０を設け、ＥＬ素子１０を出射して輝度分布制御部材２０の透明部２１に入射した光のうち、垂直な方向に向かって入射した光は直進させて出射し、斜め方向に向かって入射した光は散乱反射膜２２で散乱させて出射するようにした。



【特許請求の範囲】

【請求項１】エレクトロルミネッセンス素子の出射面に、その出射面に対向する裏面からの入射光のうち、所定の方向に向かって入射した光が直進して表面に出射し、他の方向に向かって入射した光が散乱して前記表面に出射する特性をもった輝度分布制御部材を設けたことを特徴とする面発光体。

【請求項２】前記輝度分布制御部材は、その面方向に沿って並ぶ複数の透明部とこれらの透明部の側面の間に挟まれた散乱反射膜とからなっており、前記散乱反射膜が、前記所定の方向に沿った面上にあることを特徴とする請求項１に記載の面発光体。

【請求項３】前記輝度分布制御部材の裏面は前記エレクトロルミネッセンス素子の出射面に密着していることを特徴とする請求項２に記載の面発光体。

【請求項４】前記輝度分布制御部材の透明部の屈折率は、前記エレクトロルミネッセンス素子の出射側の屈折率とほぼ同じかそれに近い値であることを特徴とする請求項３に記載の面発光体。

【請求項５】前記エレクトロルミネッセンス素子は有機エレクトロルミネッセンス素子であることを特徴とする請求項１に記載の面発光体。

【請求項６】液晶表示素子と、その背後に配置された請求項１に記載の面発光体とからなることを特徴とする液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、エレクトロルミネッセンス素子（以下、ＥＬ素子という）を用いた面発光体およびそれを使用する液晶表示装置に関するものである。

【０００２】

【従来の技術】面発光体として用いられるＥＬ素子は、例えば液晶表示装置における液晶表示素子のバックライトなどに使用されている。図７は従来のＥＬ素子のハッチングを省略した断面図であり、ここでは、有機ＥＬ素子と呼ばれるものを示している。この有機ＥＬ素子は、ガラスからなる透明基板１の一方の面に形成された透明な出射側電極２と、この出射側電極２と対向する裏側電極３との間に、有機材料からなる電界発光層４を介在させたものであり、前記出射側電極２はアノードとされ、裏側電極３はカソードとされている。

【０００３】なお、前記出射側電極２は、ＩＴＯ（インジウム・スズ酸化物）またはインジウム・亜鉛酸化物からなっており、可視光波長域に対して高い透過性を有している。前記裏側電極３は、電界発光層４への電子注入の観点から、仕事関数が小さいＭｇ系合金（Ｍｇ－Ｉｎ合金またはＭｇ－Ａｇ合金等）で形成されている。

【０００４】また、図では前記電界発光層４を１つの層として示したが、この電界発光層４は一般に、電子輸送

性発光層のアノード側に正孔輸送層を積層した二層構造、あるいは、発光層をはさんでアノード側に正孔輸送層を積層しカソード側に電子輸送層を積層した三層構造とされている。

【０００５】この有機ＥＬ素子は、その出射側電極２と裏側電極３との間に電圧（直流電圧）を印加して発光駆動されるものであり、この両電極２，３間に電圧を印加すると、電界発光層４に、出射側電極（アノード）２から正孔が、裏側電極（カソード）３から電子が注入され、その注入された正孔と電子との再結合により一重項励起子が発生して発光する。

【０００６】そして、この一重項励起子による光は、電界発光層４から出射側電極２に入射し、さらに透明基板１を透過してその表面に出射する。なお、前記一重項励起子が発する光には、電界発光層４の裏面側に向かう光もあるが、その光は裏側電極３で反射される。

【０００７】上記ＥＬ素子における電界発光層４の一点からの光の出射経路をみると、この点からの光は図７に矢線で示すように様々な方向に向かって放射するが、そのうち、出射面（基板１の表面）に垂直な方向（出射面に対する垂線に沿った方向）に向かう光は、ＥＬ素子の各層の界面および前記出射面と外気との界面を屈折や反射を生じることなく透過して垂直方向に出射する。

【０００８】一方、斜め方向に向かう放射光は、前記各層の界面に斜めに入射するため、その光は前記界面で屈折または反射する。これは、電界発光層４の出射側の屈折率、例えば三層構造の電界発光層における正孔輸送層の屈折率が１．４０～１．８０、出射側電極２の屈折率がＩＴＯの場合で約２．００、透明基板（ガラス）１の屈折率が１．４５～１．８０であり、また外気である空気の屈折率は１．０００８程度であって、隣り合う層の屈折率が互いに異なるためである。

【０００９】このため、前記斜め方向に向かう放射光は、まず電界発光層４と出射側電極２との界面Ａに入射し、その光のうち、前記界面Ａに対して全反射臨界角より小さい入射角で入射した光がこの界面Ａで屈折して出射側電極２に入射し、全反射臨界角より大きい入射角で入射した光は前記界面Ａで全反射する。

【００１０】なお、前記界面Ａで全反射した光は、裏側電極３での反射と前記界面Ａおよび電界発光層４の横方向の端面での反射とを繰り返して電界発光層４中をジグザグに屈折して進み、その過程で、前記界面Ａに全反射臨界角より小さい入射角で入射した光がこの界面Ａを透過して出射側電極２に入射する。

【００１１】また、出射側電極２に入射した光は、この出射側電極２を透過して透明基板１との界面Ｂに入射し、その光のうち、前記界面Ｂに対して全反射臨界角より小さい入射角で入射した光がこの界面Ｂで屈折して透明基板１に入射し、全反射臨界角より大きい入射角で入射した光は界面Ｂで全反射する。

【００１２】この界面Ｂで全反射した光のうちの一部の光は、電界発光層４との界面Ａでの全反射と前記界面Ｂおよび出射側電極２の横方向の端面での反射とを繰り返して出射側電極２中をジグザグに屈折して進み、その光のうち、前記界面Ｂに全反射臨界角より小さい入射角で入射した光がこの界面Ｂを透過して透明基板１に入射する。

【００１３】また、前記界面Ｂで全反射した他の光は、前記電界発光層４との界面Ａを透過して電界発光層４に戻るが、その光は、上記界面Ａで全反射した光と同様に電界発光層４中をジグザグに屈折して進み、その過程で、前記界面Ａに全反射臨界角より小さい入射角で入射した光がこの界面Ａを透過して出射側電極２に入射し、そのうちの出射側電極２との界面Ｂに全反射臨界角より小さい入射角で入射した光がこの界面Ｂを透過して透明基板１に入射する。

【００１４】さらに、出射側電極２から透明基板１に入射した光は、この透明基板１を透過してその表面と外気（空気）との界面Ｃに入射し、その光のうち、前記界面Ｃに対して全反射臨界角より小さい入射角で入射した光がこの界面Ｃで屈折して出射し、全反射臨界角より大きい入射角で入射した光は前記界面Ｃで全反射する。

【００１５】この界面Ｃで全反射した光のうちの一部の光は、出射側電極２との界面Ｂでの全反射と前記界面Ａおよび透明基板１の横方向の端面での反射とを繰り返して透明基板１中をジグザグに屈折して進み、その光のうち、前記界面Ｃに全反射臨界角より小さい入射角で入射した光がこの界面Ｃを透過して出射する。

【００１６】また、前記界面Ｃで全反射した他の光は、前記出射側電極２との界面Ｂを透過して出射側電極２に戻るか、さらに電界発光層４との界面Ａを透過して電界発光層４に戻るが、その光は、上記のように出射側電極２中または電界発光層４中をジグザグに屈折して進み、そのうちの前記界面Ａ，Ｂに全反射臨界角より小さい入射角で入射した光が再び透明基板１に入射して、その光のうち、前記外気との界面Ｃに対して全反射臨界角より小さい入射角で入射した光が出射する。

【００１７】すなわち、上記ＥＬ素子では、電界発光層４と出射側電極２との界面Ａおよび出射側電極２と透明基板１との界面Ｂに対して全反射臨界角より小さい入射角で入射してこれらの界面Ａ，Ｂを透過し、さらに出射面である前記透明基板１の表面と外気との界面Ｃに対して全反射臨界角より小さい入射角で入射した光が出射光となる。

【００１８】なお、他の光は各界面Ａ，Ｂ，Ｃのいずれかで全反射するが、これらの光は、上述したように、電界発光層４、出射側電極２、および透明基板１を屈折しながら進むが、その過程で、一部の光が前記出射側電極２や電界発光層４および透明基板１の端面から出射して漏れ光となる。

【００１９】したがって、最終的に出射面に出射する光は、出射面と外気との界面Ｃに対して全反射臨界角より小さい入射角で入射する光であり、図７に示すように、電界発光層４で発光した光の出射側電極２との界面Ａでの垂直方向（出射面に対する垂線に沿った方向）に対する角度を入射角α、出射側電極２と透明基板１との界面での前記垂直方向に対する角度を入射角β、透明基板１と外気との界面Ｃでの前記垂直方向に対する角度を入射角γ、出射面からの前記垂直方向に対する角度を出射角δとすると、最終的に出射面から出射する光、つまり出射角δが９０°より小さい範囲の光は、電界発光層４で発光した光のうちの、前記界面Ａ，Ｂ，Ｃに対して次のような入射角α，β，γで入射する光である。

【００２０】ここで、例えば電界発光層４の屈折率を１．６０、出射側電極２の屈折率を２．００、透明基板１の屈折率を１．４５、外気である空気の屈折率を１．０００８とすると、出射角δがδ≦９０°となる各界面Ａ，Ｂ，Ｃへの入射角α，β，γは、α≦３８．７°β≦３０．０°γ≦４３．６°であり、出射面（透明基板１の表面と外気との界面Ｃ）に入射する光のうち、出射面に対する入射角γが４３．６°より小さい光が出射光となる。

【００２１】

【発明が解決しようとする課題】しかし、上記従来のＥＬ素子は、その正面方向つまり出射面に垂直な方向に出射する光（出射角δ＝０°の光）の輝度は高いが、出射角δが大きくなるのにともなってその輝度が急激に低下するため、出射光の輝度分布が指向性の強い分布であり、したがって、高輝度の出射光が得られる出射角範囲が狭いという問題をもっている。

【００２２】そして、ＥＬ素子は、例えば液晶表示装置における液晶表示素子のバックライトなどに利用されているが、上記従来のＥＬ素子は、その出射光の輝度分布が指向性の強い分布であるため、このＥＬ素子を前記バックライトとする液晶表示装置は、その表示を出射面に垂直な方向に対して斜め方向から観察すると画面がかなり暗くなってしまうから、表示を充分な明るさで観察できる角度範囲が狭いという問題をもっている。

【００２３】そこで、従来から、ＥＬ素子の出射光を拡散板で拡散して出射光の輝度分布をほぼ均一にすることが考えられているが、これでは、ＥＬ素子からの高輝度の出射角範囲の出射光も拡散してその輝度が低下するため、所定の方向（例えば正面方向）に出射する光の輝度を高くすることができない。

【００２４】この発明は、ＥＬ素子を用いた面発光体として、所定の方向に出射する光の輝度を高くし、しかも充分な輝度の出射光が得られる出射角範囲を広くして出射光の輝度分布を改善することができるものを提供するとともに、あわせて、その面発光体を用いた液晶表示装置を提供することを目的としたものである。

【００２５】

【課題を解決するための手段】この発明の面発光体は、ＥＬ素子の出射面に、その出射面に対向する裏面からの入射光のうち、所定の方向に向かって入射した光が直進して表面に出射し、他の方向に向かって入射した光が散乱して前記表面に出射する特性をもった輝度分布制御部材を設けたことを特徴とするものである。

【００２６】すなわち、この発明の面発光体は、ＥＬ素子において発光してその表面に出射する光を、前記輝度分布制御部材を介して出射するようにしたものであり、この面発光体によれば、前記ＥＬ素子を出射して輝度分布制御部材にその裏面から入射した光のうち、所定の方向に向かって入射した光は直進して表面に出射し、他の方向に向かって入射した光は散乱して前記表面に出射するため、前記所定の方向への出射光の輝度を高くし、しかも充分な輝度の出射光が得られる出射角範囲を広くして出射光の輝度分布を改善することができる。

【００２７】また、この発明の液晶表示装置は、液晶表示素子の背後に、そのバックライトとして前記面発光体を配置したものであり、この面発光体は、所定の方向への出射光の輝度が高く、しかも充分な輝度の出射光が得られる出射角範囲が広いため、この液晶表示装置によれば、その表示を斜め方向から観察したときの画面の明るさの低下を少なくして、表示を充分な明るさで観察できる角度範囲を広くすることができる。

【００２８】

【発明の実施の形態】この発明の面発光体は、上記のように、ＥＬ素子の出射面に、その出射面に対向する裏面からの入射光のうち、所定の方向に向かって入射した光が直進して表面に出射し、他の方向に向かって入射した光が散乱して前記表面に出射する特性をもった輝度分布制御部材を設けることにより、所定の方向への出射光の輝度を高くし、しかも充分な輝度の出射光が得られる出射角範囲を広くして出射光の輝度分布を改善したものである。

【００２９】この発明の面発光体において、前記輝度分布制御部材は、その面方向に沿って並ぶ複数の透明部とこれらの透明部の側面の間に挟まれた散乱反射膜とからなっており、前記散乱反射膜が、前記所定の方向に沿った面上にあるものが望ましく、輝度分布制御部材をこのような構成とすれば、その裏面から前記透明部に入射する光のうち、所定の方向に向かって入射した光を直進させ、他の方向に向かって入射した光を前記散乱反射膜により散乱することができる。

【００３０】また、前記輝度分布制御部材は、その裏面をＥＬ素子の出射面に密着させて設けるのが望ましく、さらに前記透明部の屈折率は、前記ＥＬ素子の出射側の屈折率とほぼ同じかそれに近い値であるのが好ましい。

【００３１】このように、前記輝度分布制御部材の裏面がＥＬ素子の出射面に密着しているとともに、前記透明部の屈折率がＥＬ素子の出射側の屈折率とほぼ同じかそれに近い値であれば、ＥＬ素子を出射した光が効率良く輝度分布制御部材に入射するため、ＥＬ素子において発光した光を高い効率で出射させてより高輝度の出射光を得ることができる。

【００３２】また、前記ＥＬ素子は有機ＥＬ素子でよく、その場合は、有機ＥＬ素子特有のダークスポットが発生したときに、ＥＬ素子からの出射光の輝度分布に前記ダークスポットの発生箇所に対応して部分的な輝度の落ち込みが生じるが、前記輝度分布制御部材の表面に出射する光は、散乱により前記輝度の落ち込みを解消された輝度分布の光になるから、ＥＬ素子にダークスポットが発生しても、部分的な輝度の落ち込みのない良好な輝度分布の光を出射することができる。

【００３３】これは、特に前記面発光体をバックライトとする液晶表示装置において効果的であり、この液晶表示装置によれば、前記面発光体のＥＬ素子にダークスポットが発生しても、液晶表示素子には輝度の落ち込みを解消された輝度分布の光が入射するため、前記ダークスポットの発生箇所に対応する画素の輝度低下がない高品質の画像を表示することができる。

【００３４】

【実施例】図１はこの発明の第１の実施例による面発光体のハッチングを省略した断面図である。この面発光体は、ＥＬ素子１０の出射面に、その出射面に対向する裏面からの入射光のうち、所定の方向に向かって入射した光が直進して表面に出射し、他の方向に向かって入射した光が散乱して前記表面に出射する特性をもった輝度分布制御部材２０を設けたものである。

【００３５】まず、ＥＬ素子１０について説明すると、このＥＬ素子本体１０は、ガラスからなる透明基板１１の一方の面に形成された透明な出射側電極１２と、この出射側電極１２と対向する裏側電極１３との間に、有機材料からなる電界発光層１４を介在させた有機ＥＬ素子であり、その出射側電極１２はアノードとされ、裏側電極１３はカソードとされている。

【００３６】なお、前記出射側電極１２は、ＩＴＯまたはインジウム・亜鉛酸化物からなっており、前記裏側電極１３は、仕事関数が小さい、Ｍｇ－Ｉｎ合金またはＭｇ－Ａｇ合金等のＭｇ系合金で形成されている。

【００３７】ただし、前記Ｍｇ系合金は反応性が高いため、このＭｇ系合金からなる裏側電極１３が空気中の水分と反応して劣化したり、酸素と反応して酸化したりするおそれがある。

【００３８】そのため、この実施例では、図１に示したように、前記ＥＬ素子１０の周囲をその裏面全体から透明基板１１の下面にわたって気密性の高い樹脂膜１５で被覆し、前記Ｍｇ系合金からなる裏側電極１３を空気から完全に遮蔽している。

【００３９】また、図１では前記電界発光層１４を１つ

の層として示したが、この電界発光層１４は、電子輸送性発光層のアノード側に正孔輸送層を積層した二層構造か、あるいは、発光層をはさんでアノード側に正孔輸送層を積層しカソード側に電子輸送層を積層した三層構造となっている。

【００４０】なお、例えば電界発光層１４を三層構造とする場合、発光層は、ＤＰＶＢｉ｛４，４′－ビス（２，２－ジフェニルビニレン）ビフェニル｝とＢＣｚＶＢｉ｛４，４′－ビス（２－カルバゾールビニレン）ビフェニル｝とを、ＤＰＶＢｉを９６重量％、ＢＣｚＶＢｉを４重量％の割合で混合した高分子材料で形成し、正孔輸送層は、α－ＮＰＤ｛Ｎ，Ｎ′－ジ（α－ナフチル）－Ｎ，Ｎ′－ジフェニル－１，１′－ビフェニル－４，４′－ジアミン｝で形成し、電子輸送層は、Ａｌｑ３｛トリス（８－ヒドロキシキノリン）化アルミニウム｝で形成する。

【００４１】前記電界発光層１４の出射側の層の屈折率、つまりα－ＮＰＤからなる正孔輸送層の屈折率は１．４０～１．８０であり、また、出射側電極１２の屈折率はＩＴＯの場合で約２．００、透明基板（ガラス）１１の屈折率は１．４５～１．８０である。

【００４２】このＥＬ素子１０は、その出射側電極１２と裏側電極１３との間に電圧（直流電圧）を印加して発光駆動されるものであり、この両電極１２，１３間に電圧を印加すると、電界発光層１４に、出射側電極（アノード）１２から正孔が、裏側電極（カソード）１３から電子が注入され、その注入された正孔と電子との再結合により一重項励起子が発生して発光する。

【００４３】そして、この一重項励起子による光は、電界発光層１４から出射側電極１２に入射し、さらに透明基板１１を透過してその表面に出射する。なお、前記一重項励起子が発する光には、電界発光層１４の裏面側に向かう光もあるが、その光は裏側電極１３で反射される。

【００４４】なお、前記電界発光層１４が、上記ＤＰＶＢｉとＢＣｚＶＢｉからなる発光層と、α－ＮＰＤからなる正孔輸送層と、Ａｌｑ３からなる電子輸送層とを積層した三層構造である場合、この電界発光層１４において発光する光は、可視光帯域の全ての波長を含むが、そのうちの青の波長域の光量が若干多い波長成分の光であり、したがって、発光色が青味を帯びた色になる。

【００４５】そこで、この実施例では、前記電界発光層１４の発光層または出射側の正孔輸送層中に、赤の蛍光物質と緑の蛍光物質を適量ずつ分散させ、発光した光の一部を前記蛍光物質に吸収させて赤と緑の蛍光を発生させることにより、前記ＥＬ素子１０を出射する光の色を白色に近づけるようにしている。

【００４６】次に、上記輝度分布制御部材２０について説明する。図２は前記輝度分布制御部材２０の斜視図である。この輝度分布制御部材２０は、その面方向に沿って並ぶ複数の透明部２１と、これらの透明部２１の側面の間に挟まれた、両面がいずれもである散乱反射膜２２とからなるフィルムからなっており、前記散乱反射膜２２は、所定の方向に沿った面上にある。以下、この輝度分布制御部材２０を輝度分布制御フィルムという。

【００４７】なお、前記散乱反射膜２２としては、アルミニウムまたは銀等の無機金属、ポリアセチレン誘導体を含む有機金属などの反射性微結晶膜や、酸化チタン、酸化亜鉛、酸化アルミニウム、酸化マグネシウム等の金属酸化物の焼結体からなる拡散性膜を用いる。

【００４８】この輝度分布制御フィルム２０は、前記散乱反射膜２２が、フィルム面に垂直な方向に沿った面上にあるものであり、この輝度分布制御フィルム２０は、その縦横のいずれかの幅方向に沿った直線状の散乱反射膜２２が前記透明部２１の幅に相当する間隔で互いに平行に並んでいるルーバー状をなしている。

【００４９】なお、このルーバー状の輝度分布制御フィルム２０は、例えば、前記透明部２１の幅に相当する厚さの透明な樹脂層と前記散乱反射膜２２とを交互に積層し、その積層グロックを厚さ方向（積層方向）に垂直な切断面に沿ってフィルム状にスライスする方法で製造できる。

【００５０】また、前記輝度分布制御フィルム２０の透明部２１は、屈折率が上記ＥＬ素子１０の出射側の屈折率（この実施例では透明基板１１の屈折率）とほぼ同じかそれに近い値である透明樹脂からなっている。

【００５１】なお、ＥＬ素子１０の出射側の屈折率、つまりガラスからなる透明基板１１の屈折率は１．４５～１．８０であるが、それとほぼ同じかまたは近い値の屈折率をもつ透明樹脂としては、ＰＥＴ（ポリエチレンテレフタレート）、ＰＥＳ（ポリエーテルサルフォン）、ＰＣ（ポリカーボネート）等があり、これらの樹脂の屈折率は１．４０～１．６０である。

【００５２】そして、前記輝度分布制御フィルム２０は、上記ＥＬ素子１０の出射面に、フィルム裏面をＥＬ素子１０の出射面（透明基板１１の表面）に密着させて設けられている。なお、この実施例では、輝度分布制御フィルム２０を、その透明部２１の屈折率とＥＬ素子１０の透明基板１１の屈折率のうちの一方とほぼ同じか、あるいは両方の屈折率の間の屈折率をもった透明接着剤（図示せず）によりＥＬ素子１０に接着している。

【００５３】上記面発光体は、ＥＬ素子１０の電界発光層１４において発光してＥＬ素子１０の表面に出射する光を、前記輝度分布制御フィルム２０を介して出射するようにしたものである。

【００５４】まず、ＥＬ素子１０の電界発光層１４において発光した光のＥＬ素子表面への出射経路を、前記電界発光層１４の一点からの光についてみると、この点からの光は図１に矢線で示すように様々な方向に向かって放射するが、そのうち、ＥＬ素子１０の出射面に垂直な

方向（出射面に対する垂線に沿った方向）に向かう光は、電界発光層１４と出射側電極１２との界面Ａ′および前記出射側電極１２と透明基板１１との界面Ｂ′を屈折や反射を生じることなく透過してＥＬ素子表面に垂直に出射する。

【００５５】一方、斜め方向に向かう放射光は、前記各界面Ａ′，Ｂ′に斜めに入射するが、前記電界発光層１４と出射側電極１２および透明基板１１の屈折率は上述したような値であって隣り合う層の屈折率が互いに異なるため、前記斜め方向に向かう放射光は、前記各界面Ａ′，Ｂ′で屈折または反射する。

【００５６】すなわち、斜め方向に向かう放射光は、まず電界発光層１４と出射側電極１２との界面Ａ′に入射し、その光のうち、前記界面Ａ′に対して全反射臨界角より小さい入射角で入射した光がこの界面Ａ′で屈折して出射側電極１２内に入射し、全反射臨界角より大きい入射角で入射した光は前記界面Ａ′で全反射する。

【００５７】なお、前記界面Ａ′で全反射した光は、裏側電極１３で反射されるとともに前記界面Ａ′および電界発光層１４の端面で反射して電界発光層１４中をジグザグに屈折して進み、その過程で、前記界面Ａ′に全反射臨界角より小さい入射角で入射した光がこの界面Ａ′を透過して出射側電極２内に入射する。

【００５８】また、出射側電極１２に入射した光は、この出射側電極１２内を透過して透明基板１１との界面Ｂ′に入射し、その光のうち、前記界面Ｂ′に対して全反射臨界角より小さい入射角で入射した光がこの界面Ｂ′で屈折して透明基板１１内に入射し、全反射臨界角より大きい入射角で入射した光は界面Ｂ′で全反射する。

【００５９】この界面Ｂ′で全反射した光のうちの一部の光は、電界発光層１４との界面Ａ′での全反射と前記界面Ｂ′および出射側電極１２の横方向の端面での反射を繰り返して出射側電極１２中をジグザグに屈折して進み、その光のうち、前記界面Ｂ′に全反射臨界角より小さい入射角で入射した光がこの界面Ｂ′を透過して透明基板１１に入射する。

【００６０】また、前記界面Ｂ′で全反射した他の光は、前記電界発光層１４との界面Ａ′を透過して電界発光層１４に戻るが、その光は、上記界面Ａ′で全反射した光と同様に電界発光層１４中をジグザグに屈折して進み、その過程で、前記界面Ａ′に全反射臨界角より小さい入射角で入射した光がこの界面Ａ′を透過して出射側電極２に入射し、そのうちの出射側電極２との界面Ｂ′に全反射臨界角より小さい入射角で入射した光がこの界面Ｂ′を透過して透明基板１１に入射する。

【００６１】そして、出射側電極１２から透明基板１１に入射した光は、この透明基板１１を透過してその表面に出射し、上記輝度分布制御フィルム２０の透明部２１にその裏面から入射する。

【００６２】この場合、この実施例では、前記輝度分布制御フィルム２０の透明部２１の屈折率を、ＥＬ素子１０の出射側の屈折率（透明基板１１の屈折率）とほぼ同じかそれに近い値にするとともに、この輝度分布制御フィルム２０を、その透明部２１の屈折率とＥＬ素子１０の透明基板１１の屈折率のうちの一方とほぼ同じか、あるいは両方の屈折率の間の屈折率をもった図示しない透明接着剤によりＥＬ素子１０に接着しているため、ＥＬ素子１０の表面と輝度分布制御フィルム２０との界面Ｃ′に入射した光は、その入射角がどのような角度であっても、そのほとんどが全反射することなく前記界面Ｃ′を透過して輝度分布制御フィルム２０の透明部２１に入射する。

【００６３】次に、前記輝度分布制御フィルム２０の透明部２１に入射した光の出射経路を説明すると、この透明部２１にその裏面から入射した光のうち、散乱反射膜２２に沿った方向、つまり輝度分布制御フィルム２０のフィルム面に垂直な方向に向かって入射した光（ＥＬ素子１０から垂直に出射した光）は、前記透明部２１を直進して輝度分布制御フィルム２０の表面に垂直に出射する。

【００６４】一方、前記透明部２１に他の方向に向かって入射した光、つまり輝度分布制御フィルム２０のフィルム面に対して斜めに入射した光は、透明部２１を斜めに透過してその側面の散乱反射膜２２に入射し、その散乱反射面で散乱する。

【００６５】なお、前記透明部２１を斜めに透過する光のなかには、前記散乱反射膜２２に入射せずにそのまま透明部２１の表面に達する光もあり、その光は、散乱することなく輝度分布制御フィルム２０の表面に出射する。この出射光は、透明部２１の表面と外気との界面Ｄ′において、この界面Ｄ′に対する入射角と、前記透明部２１と外気（空気）との屈折率差に応じて屈折し、その方向に出射する。

【００６６】前記散乱反射膜２２で散乱した光は、透明部２１中を様々な方向に向かって進み、そのうちの透明部２１の表面に向かう光が、前記外気との界面Ｄ′に入射する。

【００６７】なお、他の方向に向かう光は、直接は前記界面Ｄ′に入射しないが、その光のほとんどが反対側の散乱反射膜２２に入射して再び散乱し、その散乱光のうちの透明部２１の表面に向かう光が前記界面Ｄ′に入射するため、前記透明部２１に入射した光はそのほとんどが前記界面Ｄ′に入射する。

【００６８】そして、前記透明部２１の表面と外気との界面Ｄ′に入射した光のうち、前記界面Ｄ′に対して全反射臨界角より小さい入射角で入射した光は、この界面Ｄ′を透過して輝度分布制御フィルム２０の表面に出射する。この出射光は、前記界面Ｄ′において、この界面Ｄ′に対する入射角と、前記透明部２１と外気（空気）

との屈折率差に応じて屈折し、その方向に出射する。

【００６９】また、前記界面Ｄ′に全反射臨界角より大きい入射角で入射した光は、この界面Ｄ′で全反射するが、その光はその反射方向の散乱反射膜２２に入射して再び散乱するため、これらの光も最終的には前記界面Ｄ′に全反射臨界角より小さい入射角で入射し、この界面Ｄ′を透過して輝度分布制御フィルム２０の表面に出射する。

【００７０】このように、上記面発光体によれば、ＥＬ素子１０を出射して輝度分布制御フィルム２０にその裏面から入射した光のうち、垂直な方向に向かって入射した光は直進して表面に出射し、他の方向に向かって入射した光は散乱して前記表面に出射するため、前記垂直な方向への出射光の輝度を高くし、しかも充分な輝度の出射光が得られる出射角範囲を広くして出射光の輝度分布を改善することができる。

【００７１】なお、輝度分布制御フィルム２０において散乱した光のなかには、前記輝度分布制御フィルム２０の表面と外気との界面Ｄ′に垂直に入射する光もあり、その光は前記界面Ｄ′で屈折することなく垂直に出射するため、前記垂直な方向への出射光の輝度は、輝度分布制御フィルム２０を垂直に透過して表面に出射する直進光の輝度よりもさらに高くなる。

【００７２】しかも、上記面発光体によれば、ＥＬ素子１０を出射して輝度分布制御フィルム２０の各透明部２１に入射した光のうち、最終的な出射面である前記透明部２１の表面と外気との界面Ｄ′に向かって全反射臨界角より大きい入射角で進む光が散乱して方向を変え、その光が前記界面Ｄ′に全反射臨界角より小さい入射角で入射してこの界面Ｄ′を透過して出射するため、ＥＬ素子１０から輝度分布制御フィルム２０に入射した光の出射効率を高くすることができる。

【００７３】さらに、従来のＥＬ素子では、図７に示したように、各界面Ａ，Ｂ，Ｃで全反射した光が電界発光層４、出射側電極２、および透明基板１を屈折しながら進む過程で、その一部の光が前記出射側電極２や電界発光層４および透明基板１の端面から出射して漏れ光となるため、ＥＬ素子を出射するまでの過程での光のロスが大きく、したがって電界発光層４での発光エネルギーに比べて出射光量がかなり少なくなるが、上記面発光体によれば、ＥＬ素子１０を出射するまでの過程での光のロスも少ない。

【００７４】すなわち、上記面発光体においても、図１に示したように、界面Ａ′およびＢ′で全反射した光が電界発光層１４および出射側電極１２を屈折しながら進む過程で、その一部の光が前記出射側電極２や電界発光層４および透明基板１の端面から出射して漏れ光となるが、透明基板１１に入射した光は、上述したように、透明基板１１と輝度分布制御フィルム２０との界面Ｃ′に対する入射角がどのような角度であっても、そのほとんどが全反射することなく前記界面Ｃ′を透過して輝度分布制御フィルム２０の透明部２１に入射するため、従来のＥＬ素子のような透明基板の端面からの漏れ光はほとんど生じない。

【００７５】したがって、上記面発光素子によれば、ＥＬ素子１０を出射し、さらに輝度分布制御フィルム２０を透過して出射する光量を、従来のＥＬ素子の出射光量に比べて飛躍的に多くして（少なくとも２倍以上）、高輝度の出射光を得ることができる。

【００７６】図３は上記面発光体の出射光の輝度分布を、従来のＥＬ素子の輝度分布およびそのＥＬ素子の出射面に拡散板を配置したときの輝度分布と比較して示す図であり、実線は上記実施例の面発光体の輝度分布、破線は従来のＥＬ素子の輝度分布、一点鎖線は従来のＥＬ素子の出射面に拡散板を配置したときの輝度分布を示している。

【００７７】なお、図３に示した上記面発光体の輝度分布は、面発光体の出射面（輝度分布制御フィルム２０の表面）に垂直でかつ輝度分布制御フィルム２０の透明部２１および散乱反射膜２２の長さ方向に対して直交する方向に沿った面上における輝度分布であり、図において、＋θは出射面に垂直な方向（出射角θ＝０°の方向）に対して一方の方向に出射する光の出射角、－θは前記垂直な方向に対して反対方向に出射する光の出射角である。

【００７８】この図３のように、従来のＥＬ素子の輝度分布は、正面方向（出射面に垂直な方向）に出射する光の輝度は高いが、出射角が大きくなるのにともなってその輝度が急激に低下する、指向性の強い分布であり、したがって、高輝度の出射光が得られる出射角範囲が狭い。

【００７９】また、従来のＥＬ素子の出射面に拡散板を配置したときの輝度分布は、ほぼ均一な分布であるが、ＥＬ素子からの高輝度の出射角範囲の出射光も拡散するため、正面方向に出射する光の輝度が、従来のＥＬ素子に比べてかなり低い。

【００８０】これらに比べて、上記実施例の面発光体の輝度分布は、正面方向への出射光の輝度が高く、しかも充分な輝度の出射光が得られる出射角範囲が広い分布であり、しかも、輝度分布制御フィルム２０を垂直に透過して表面に出射する直進光のほかに、前記輝度分布制御フィルム２０において散乱した光のうちの外気との界面Ｄ′に垂直に入射した光も垂直に出射するため、正面方向に出射する光の輝度が従来のＥＬ素子よりもさらに高い。

【００８１】また、上記実施例の面発光体は、そのＥＬ素子１０として、導電性高分子からなる電界発光層１４を備えた有機ＥＬ素子を用いており、有機ＥＬ素子はその電界発光層１４の光の透過率が高いため、発光した光を効率良く出射することができる。

【００８２】また、前記有機ＥＬ素子は、その電界発光層１４が有機材料からなっているため、この電界発光層１４と金属材料からなる出射側電極１２との界面にダークスポットと呼ばれる発光不良部分が発生することがあり、このダークスポットが発生すると、ＥＬ素子１０からの出射光の輝度分布に前記ダークスポットの発生箇所に対応して部分的な輝度の落ち込みが生じるが、前記輝度分布制御フィルム２０の表面に出射する光は、散乱により前記輝度の落ち込みを解消された輝度分布の光であるため、上記面発光体によれば、ＥＬ素子１０に有機ＥＬ素子特有のダークスポットが発生しても、輝度の落ち込みを解消された輝度分布の光になるから、ＥＬ素子１０にダークスポットが発生しても、部分的な輝度の落ち込みのない良好な輝度分布の光を出射することができる。

【００８３】図４はこの発明の第２の実施例による面発光体のハッチングを省略した断面図である。この実施例の面発光体は、ＥＬ素子１０の透明基板を輝度分布制御フィルム２０で兼用したものであり、ＥＬ素子１０の基本的な構造と、輝度分布制御フィルム２０の構造は、上記第１の実施例と同じである。

【００８４】ただし、この実施例では、前記輝度分布制御フィルム２０の透明部２１を、屈折率が、ＥＬ素子１０の出射側の屈折率（電界発光層１４を三層構造とする場合は、その出射側の層である正孔輸送層の屈折率）とほぼ同じかそれに近い値である透明樹脂で形成している。

【００８５】この実施例の面発光体によれば、ＥＬ素子１０を出射する光、つまりＥＬ素子１０と輝度分布制御フィルム２０との界面に入射した光が、その入射角がどのような角度であっても、全反射することなく前記界面を透過して輝度分布制御フィルム２０の透明部２１に入射するため、ＥＬ素子１０の電界発光層１４で発光した光がＥＬ素子１０を出射する過程での全反射は、その出射経路を図４に矢線で示したように、電界発光層１４と出射側電極１２との界面で発生するだけであり、したがって全反射した光の漏れは、ほぼ電界発光層１４の端面からの漏れだけになるため、上記第１の実施例よりもさらに出射光量を多くすることができる。

【００８６】なお、上記第１および第２の実施例では、輝度分布制御フィルム２０として、散乱反射膜２２がフィルム面に垂直な方向に沿った面上にあるものを用いたが、前記散乱反射膜２２の散乱反射面は傾斜面であってもよい。

【００８７】このような輝度分布制御フィルムを用いれば、ＥＬ素子を出射して輝度分布制御フィルムにその裏面から入射した光のうち、散乱反射膜２２に沿った方向に向かって入射した光が直進して表面に出射し、他の方向に向かって入射した光は散乱して前記表面に出射するため、斜め方向への出射光の輝度を高くし、しかも充分

な輝度の出射光が得られる出射角範囲を広くして出射光の輝度分布を改善することができる。

【００８８】また、上記実施例では電界発光層１４として、青色の光を発する発光層に赤の蛍光を発する蛍光物質と緑の蛍光を発する蛍光物質とを分散状態に含有させたものを用いたが、これに限らず、例えば赤色の光を発するドット状の発光層と、緑色の光を発するドット状の発光層と、青色の光を発するドット状の発光層とを交互に並べて形成して、ＥＬ素子１０を出射する光の色を白色にするようにしてもよい。

【００８９】さらに、上記実施例では、ＥＬ素子１０の出射面に設ける輝度分布制御部材として、直線状の散乱反射膜２２が透明部２１の幅に相当する間隔で互いに平行に並んでいるルーバー状の輝度分布制御フィルム２０を用いたが、前記輝度分布制御部材は、透明なフィルム中に散乱反射膜を格子状に設けたものでも、透明フィルム中に長さの短い散乱反射膜を縦幅方向および横幅方向に適当なピッチで設けたものでもよい。

【００９０】図５は輝度分布制御部材の変形例を示す斜視図であり、この輝度分布制御部材は、上記実施例で用いたルーバー状の輝度分布制御フィルム２０を２枚、それぞれの散乱反射膜２２の長さ方向を互いに直交させて重ね合わせたものである。

【００９１】このような輝度分布制御部材を用いれば、散乱反射膜２２が格子状に設けられているため、入射光が互いに直交する２つの方向に散乱するから、前記２つの方向の出射光の輝度分布をそれぞれ図３のような分布にすることができる。

【００９２】なお、上記輝度分布制御部材は、透明なフィルム中に散乱反射膜を設けたものに限らず、裏面からの入射光のうち、所定の方向に向かって入射した光が直進して表面に出射し、他の方向に向かって入射した光が散乱して前記表面に出射する特性をもったものであればよい。

【００９３】次に、上記面発光体を用いた液晶表示装置について説明する。図６は前記液晶表示装置の一実施例を示す側面図であり、この液晶表示装置は、液晶表示素子３０の背後に、そのバックライト３６として、上述した面発光体を配置したものである。

【００９４】上記液晶表示素子３０は、単純マトリックスまたはアクティブマトリックス方式のＥＣＢ（複屈折効果）型液晶表示素子であり、枠状シール材３３を介して接合した一対の透明な電極形成基板３１，３２間に、液晶分子が所定の配向状態（例えばツイスト配向状態）に配向した液晶層を設けるとともに、前記基板３１，３２の外面にそれぞれ偏光板３４，３５を配置したものである。

【００９５】このＥＣＢ型液晶表示素子３０は、液晶層の複屈折作用と偏光板３４，３５の偏光作用とを利用して着色光を得るものであり、一方の偏光板を透過して入

射した直線偏光が、液晶層を透過する過程で液晶の複屈折作用により各波長光がそれぞれ偏光状態の異なる楕円偏光となった光となり、その光が他方の偏光板に入射して、この他方の偏光板を透過した光が、その光を構成する各波長光の光強度の比に応じた色の着色光になる。

【００９６】すなわち、このＥＣＢ型液晶表示素子３０は、カラーフィルタを用いずに着色光を得るものであり、したがってカラーフィルタによる光の吸収がないから、光の透過率を高くして、明るいカラー表示を得ることができる。

【００９７】そして、ＥＣＢ型液晶表示素子３０は、その両基板３１，３２の電極間に印加される電圧に応じた液晶分子の配向状態によって液晶の複屈折性が変化し、それに応じて他方の偏光板に入射する各波長光の偏光状態が変化するため、印加電圧を制御することによって着色光の色を変化させ、同じ画素で複数の色を表示して、フルカラー画像等の多色カラー画像を表示することができる。

【００９８】また、この実施例では、前記バックライト３６として、図１に示した第１の実施例の面発光体を用いている。この面発光体の構成の説明は、図に同符号を付して省略する。

【００９９】この液晶表示装置は、その液晶表示素子３０のバックライト３６として、上述したような、所定の方向への出射光の輝度が高く、しかも充分な輝度の出射光が得られる出射角範囲が広い面発光体を用いているため、その表示を斜め方向から観察したときの画面の明るさの低下を少なくして、表示を充分な明るさで観察できる角度範囲を広くすることができる。

【０１００】しかも、上記面発光体は、ＥＬ素子１０を出射し、さらに輝度分布制御フィルム２０を透過して出射する光量が、従来のＥＬ素子の出射光量に比べて飛躍的に多いものであるため、高輝度の光を液晶表示素子３０に入射させ、高輝度の画像を表示させることができる。

【０１０１】また、上記液晶表示装置は、バックライト３６に上記面発光体を用いたものであり、この面発光体の発光源であるＥＬ素子１０の裏側電極１３で光を反射することができるため、前記ＥＬ素子１０を発光駆動せずに、液晶表示素子３０の出射面側から入射する外光（自然光または室内照明光）を図６に破線で示すように前記ＥＬ素子１０の裏側電極１３で反射させて表示することも可能であり、したがって、バックライト３６からの光を利用する透過型表示と、外光を利用する反射型表示との両方を行なえる、いわゆる２ウエイ表示装置として使用することができる。

【０１０２】この場合、上記実施例の面発光体は、ＥＬ素子１０に、その電界発光層１４の光の透過率が高い有機ＥＬ素子を用いたものであるため、発光した光を効率良く出射することができるだけでなく、反射型表示を行

なう場合も、入射した外光を裏側電極１３で効率良く反射して明るい表示を得ることができる。

【０１０３】また、前記面発光体の輝度分布制御フィルム２０を、その各散乱反射膜２２を液晶表示素子３０の各画素の行間および列間にそれぞれ対応させて格子状に設けたものとし、前記液晶表示素子３０に前記格子状の散乱反射膜２２に対応したブラックマスクを設ければ、散乱反射膜２２自体の光反射による表示のちらつきを防止できるとともに、ＥＬ素子１０からの出射光を効率良く液晶表示素子３０の各画素に入射することができる。

【０１０４】なお、前記ＥＬ素子１０は、有機ＥＬ素子特有のダークスポットを発生することがあるが、その場合でも、面発光体からの出射光（輝度分布制御部材の表面に出射する光）は、散乱により前記輝度の落ち込みを解消された輝度分布の光になるから、部分的な輝度の落ち込みのない良好な輝度分布の光を液晶表示素子３０に入射させて、高品質の画像を表示することができる。

【０１０５】しかも、この液晶表示装置では、液晶表示素子３０として、カラーフィルタを用いずに着色光を得るＥＣＢ型液晶表示素子を用いているため、外光を利用する反射型表示においても、充分に明るいカラー画像を表示することができる。

【０１０６】また、前記ＥＣＢ型液晶表示素子３０は、液晶層の複屈折作用と偏光板３４，３５の偏光作用とを利用して着色光を得るものであるため、例えば各画素の色を赤、緑、青に変化させてフルカラー画像を表示しようとしても、全ての表示色を高い色純度で得られるとは限らないが、ＥＣＢ型液晶表示素子３０では高い色純度が得にくい色に対応した色の蛍光を発する蛍光物質を上記ＥＬ素子１０の電界発光層１４に添加しておけば、色バランスの良いカラー画像を表示することができる。

【０１０７】なお、上記実施例の液晶表示装置に用いた液晶表示素子３０はＥＣＢ型のものであるが、バックライト３６である面発光体からの光を利用する透過型専用の表示装置の場合は、前記液晶表示素子３０はカラーフィルタを用いてカラー画像を表示するものであってもよい。

【０１０８】

【発明の効果】この発明の面発光体は、ＥＬ素子の出射面に、その出射面に対向する裏面からの入射光のうち、所定の方向に向かって入射した光が直進して表面に出射し、他の方向に向かって入射した光が散乱して前記表面に出射する特性をもった輝度分布制御部材を設けたものであるから、所定の方向に出射する光の輝度を高くし、しかも充分な輝度の出射光が得られる出射角範囲を広くして出射光の輝度分布を改善することができる。

【０１０９】この発明の面発光体において、前記輝度分布制御部材は、その面方向に沿って並ぶ複数の透明部とこれらの透明部の側面の間に挟まれた散乱反射膜とからなっており、前記散乱反射膜が、前記所定の方向に沿っ

た面上にあるものが望ましく、輝度分布制御部材をこのような構成とすれば、その裏面から前記透明部に入射する光のうち、所定の方向に向かって入射した光を直進させ、他の方向に向かって入射した光を前記散乱反射膜により散乱することができる。

【０１１０】また、前記輝度分布制御部材は、その裏面をＥＬ素子の出射面に密着させて設けるのが望ましく、さらに前記透明部の屈折率は、前記ＥＬ素子の出射側の屈折率とほぼ同じかそれに近い値であるのが好ましい。このようにすれば、ＥＬ素子を出射した光が効率良く輝度分布制御部材に入射するため、ＥＬ素子において発光した光を高い効率で出射させてより高輝度の出射光を得ることができる。

【０１１１】また、前記ＥＬ素子は有機ＥＬ素子でよく、その場合は、有機ＥＬ素子特有のダークスポットが発生したときに、ＥＬ素子からの出射光の輝度分布に前記ダークスポットの発生箇所に対応して部分的な輝度の落ち込みが生じるが、前記輝度分布制御部材の表面に出射する光は、散乱により前記輝度の落ち込みを解消された輝度分布の光になる。

【０１１２】また、この発明の液晶表示装置は、液晶表示素子の背後に、そのバックライトとして前記面発光体を配置したものであり、この面発光体は、所定の方向への出射光の輝度が高く、しかも充分な輝度の出射光が得られる出射角範囲が広いため、この液晶表示装置によれば、その表示を斜め方向から観察したときの画面の明るさの低下を少なくして、表示を充分な明るさで観察できる角度範囲を広くすることができる。

【図面の簡単な説明】

【図１】この発明の第１の実施例による面発光体のハッチングを省略した断面図。

【図２】前記面発光体に用いた輝度分布制御部材の斜視図。

【図３】前記面発光体の出射光の輝度分布を、従来のＥＬ素子の輝度分布およびそのＥＬ素子の出射面に拡散板を配置したときの輝度分布と比較して示す図。

【図４】この発明の第２の実施例による面発光体のハッチングを省略した断面図。

【図５】輝度分布制御部材の変形例を示す斜視図。

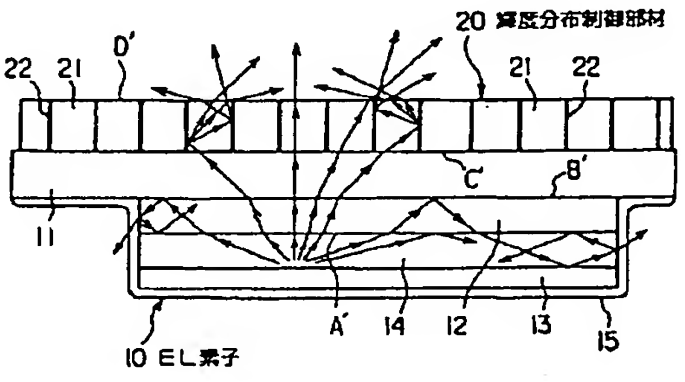
【図６】この発明の液晶表示装置の一実施例を示す側面図。

【図７】従来のＥＬ素子のハッチングを省略した断面図。

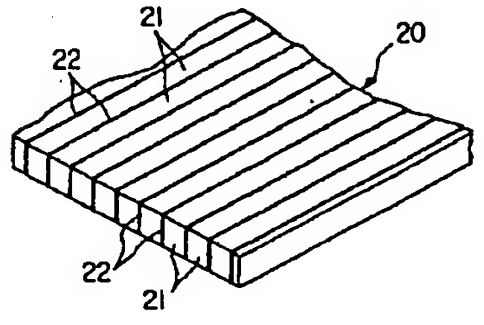
【符号の説明】

１０…ＥＬ素子
１１…透明基板
１２…出射側電極
１３…裏側電極
１４…電界発光層
２０…輝度分布制御部材
２１…透明部
２２…散乱反射膜
３０…液晶表示素子
３６…バックライト（面発光体）

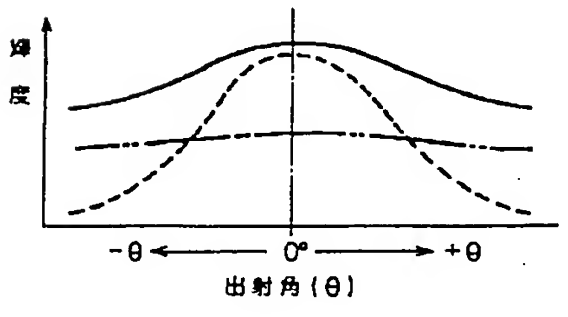
【図１】



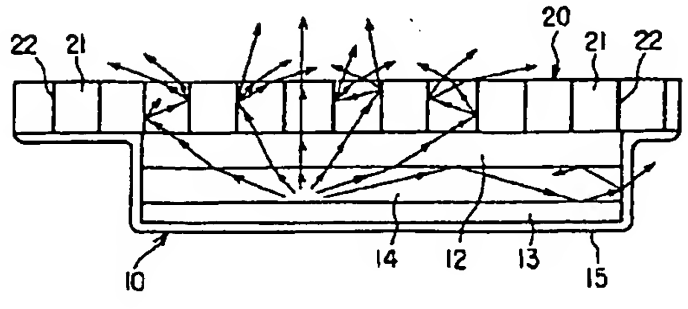
【図２】



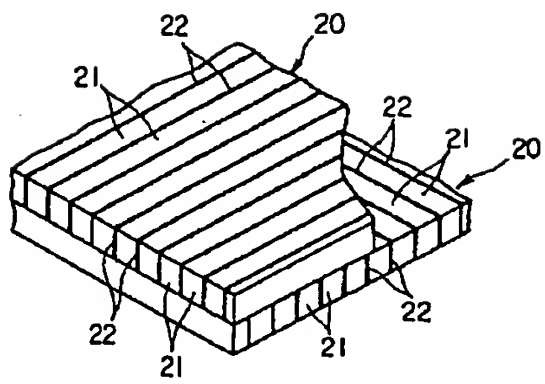
【図３】



【図４】



【図５】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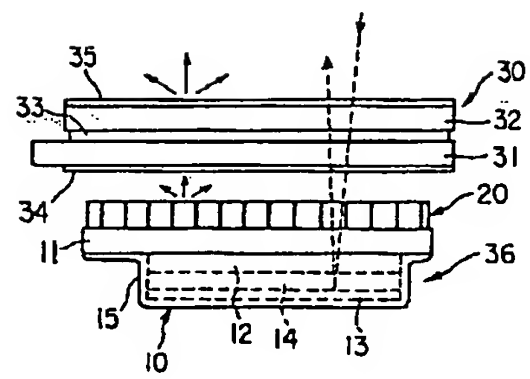
【図６】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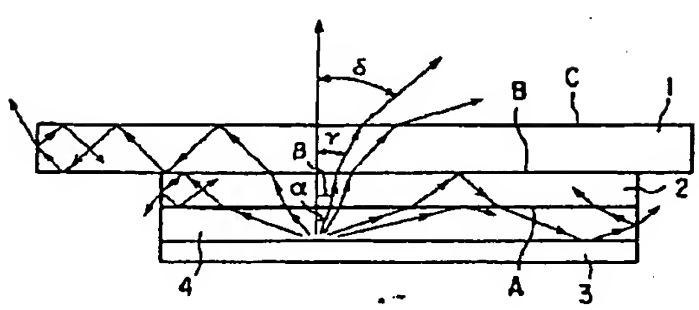
【図７】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